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Protection for Indian Sericulture.

THE Tariff Board have now completed their enquiry into the present condition of the Indian Sericultural Industry, and their report is awaited with anxious interest by all who have realised the importance of the industry to India.

The production of raw silk in India is confined at present to Mysore, Bengal, Madras and Kashmir. The industry is also practised in a few villages in Assam and the Punjab. The total silk production today is approximately :

	Lbs.
Mysore ..	800,000
Bengal ..	500,000
Madras ..	115,000
Kashmir ..	250,000

To the above may be added about 4,000 lbs. produced in Assam and the Punjab.

The total consumption of silk in India at the present time may be taken at about 42 lakhs of pounds, including about 25½ lakhs of pounds of imported foreign silk.

Conditions in India are favourable for silk production ; and if adequately protected from aggressive foreign competition during the period of re-organisation, the Indian production of silk can be developed to meet the entire Indian demand. The Tariff Board in 1933 reported :

"We are satisfied that the climate of great portions of India affords facilities for the cultivation of mulberry, and for the rearing of silk-worms" (p. 136).

"We are equally satisfied that the industry cannot exist without protection, much less develop rapidly" (p. 140).

It is not easy to put the case for protection better or more convincingly than has been done in Chapter XII of the Report of the Tariff Board of 1933, which may be regarded as a classic on the subject. It proves conclusively that the Indian Silk Industry satisfies the Fiscal Commission's requirement to qualify for protection, that the industry should not only have an important place in the country's economic life, but should be one for which the country has special advantages ; that its present position should be such that it cannot exist without protection against foreign competition ; and that if protected adequately during the period of development, it should be capable of maintaining itself in future without protection.

Though their findings on essential facts were correct, the Tariff Board's recommendations were unfortunately timid and inadequate. At a time when intense foreign competition was causing a rapid and continuous fall in prices, they recommended the levy of a specific duty of Rs. 2–6–0 per pound on imported silk, or in the alternative, a duty of 50% *ad valorem* whichever was higher. Even as the Government of India were considering this recommendation, it had already become inadequate; yet, the Government of India, while recognising the title of Sericulture to protection sanctioned a measure which fell much short even of this proposal. They sanctioned a duty of 25% *ad valorem, plus* a specific duty of Re. 0–14–0 per pound of silk, which on the prices then prevailing, worked out to a total of about Rs. 1–10–0 per pound. As the ex-duty price of foreign silk had by then dropped to Rs. 3–11–5, that silk could be bought in Indian markets at Rs. 5–6–0 while according to the Tariff Board's own finding Indian *Charaka* silk of competing quality could not be offered at less than Rs. 6–2–6, and Indian Filature silk at less than Rs. 6–10–9 per pound. The result, as may be expected, was that the duty has been found too low to be effective as protection, and that Indian Sericulture exposed as it is to the full blast of foreign competition, has not been able to organise itself. The attack is now from the State-aided sericulture of Japan, and is ruthless in character. Though Indian Sericulture has been putting up a gallant fight for its existence—it has been steadily losing ground, and is in greater danger to-day than it was five years ago.

The present Tariff Board has been appointed to review the situation and to submit fresh proposals in the light of five years' experience. From the very complete questionnaire issued by them, it is evident that they wish to ascertain whether, and if so to what extent, the Indian Sericultural Industry has responded to the "protection" extended to it during this period, and whether the Governments concerned have taken adequate action in the discharge of their correlative duty to stimulate and organise it under the shelter of this protection.

There can be no possible doubt that the silk industry of India has suffered a serious set-back during the past five years. We have not to hand figures relating to other states and provinces, but the shrinkage of the mulberry area in Mysore, which produces about half the total Indian output, may perhaps afford an indication of the extent of this loss:

		Acres
1933–34	..	32,869
1934–35	..	30,228
1935–36	..	28,528
1936–37	..	25,131
1937–38	..	26,500

This contraction has taken place in spite of the Mysore Government's utmost efforts, and the stout-hearted optimism of the Mysore peasant, simply because the so-called protective duty gives no protection at all.

For real protection, the duty should at least bridge the gap between the cost of production of the article at home, and the price at which the competing foreign product is offered for sale, at any rate in home markets. Whether the duty in any case *does* bridge the gap is a point of fact, not of degree, and certainly not of opinion. A partial bridge may be evidence of good intention, but is not protection. It is like leaping a chasm, just a trifle short. Inadequate protection is appreciably worse than no protection at all, for it lures men to their loss by creating an illusion of safety. In the present case, in spite of the so-called protection granted by the Government of India—and partly no doubt even because of it—the area under mulberry in Mysore has steadily dropped from 32,869 acres in 1933–34 to 26,000 acres in 1937–38. This drop has not been due to any competing crop or occupation, but directly to failure in fact to protect.

When it is admitted, as it is by the Tariff Board of 1933 in their report, and by the Government of India in accepting it, that the silk industry is one which can and ought to be protected, the only issue now before the Tariff Board and the Government of India becomes narrowed to this:—

What should the duty be to operate as a real protection?

The answer depends essentially on the cost of production of the grade of Indian silk which can compete with foreign imports. The quality should be as good as that of competing foreign silk. This means, that we have to take the cost of production of Indian silk in Filatures of modern type. The cost of production in the crude *Charaka* now generally in use, is of course lower, but *Charaka* silk is defective, and has no future,

Owing to the changed character of the Indian demand as a result of the impact of foreign imports, *Charaka* silk has definitely lost favour, and is maintaining a precarious foothold by a ruinous sacrifice in prices. It has no chance of survival. Therefore, the problem is not now one of protecting *Charaka* silk. Charakas are bound to go; and if Filatures do not take their place, Sericulture will go with them. Filatures are essential to the stability of Indian Sericulture as they alone can make an effective demand for cocoons, and as they alone can meet the competition of foreign silk and satisfy the requirements of the Indian weaver.

We shall now state what we mean by an effective demand for cocoons. For cocoons, as for other goods, there is a return, below which the producer will not consent to produce. The last Tariff Board, after going carefully into this question, found Re. 0–5–0 a pound a reasonable price. This estimate was by no means too generous, for the barest cost of production in Mysore and Kollegal is about Re. 0–4–5 per pound, not taking into account remuneration for the work of the family. The production of cocoons by an average family may be taken at about 550 lbs. a year, which, if the cocoons realised Re. 0–5–0 a pound, would add about Rs. 20 a year to the family budget—not a very attractive return for a year's almost continuous work, but one which, in the peculiar circumstances of the case, has been found just enough to prevent the family from giving up the industry. That Re. 0–5–0 per pound is the minimum price at which cocoons will continue to be produced, receives convincing corroboration from the statistical figures.

In spite of the "Protection" granted in 1934 the price of cocoons remained as a rule below Re. 0–4–0 per pound till the end of 1936, and during this period the acreage under mulberry fell from 32,869 to about 26,000. In 1937, the prices went up, and fluttered at a level above five annas. During this brief and fitful prosperity, an additional area of about 2,500 acres was planted with mulberry. About the middle of 1937, the prices showed a downward tendency and in October of that year dropped sharply below the 5 annas level. They have moved down grade, and are yet round about 4½ annas. This sharp decline resulted almost immediately in the neglect and even abandonment of the new plantations.

This indicates:

(1) When the price of cocoons rises above five annas per pound, there is a tendency towards expansion of the mulberry area.

(2) When it falls below that level, there is a tendency towards contraction.

It is needless to say that the area under mulberry is a sure index of Sericulture.

A price of five annas per pound is therefore the minimum below which the average rearer will have no inducement to produce cocoons. We have also explained why Filatures are essential to the industry. The irresistible conclusion is that there can be no effectful protection of the industry, unless Filatures are placed in a position to pay Re. 0–5–0 per pound for cocoons. In other words, the pitch of the protective duty should be adequate to raise the price of Filature silk to a level such as would enable Indian filatures to pay five annas a pound for their cocoons and to make a reasonable manufacturing profit. According to careful estimates, the cost of production of a pound of Filature silk in India works out to Rs. 7–0–0. Adding to this 6¼% for incidental and selling costs, we reach a fair selling price of Rs. 7–7–0 per pound.

To arrive at the protection necessary, we have to ascertain the ex-duty price of imported silk. The safest way of doing this would be to take the actual price of foreign silk in Indian markets, and work back by deducting the duty and other charges. A fixed Tariff valuation like that now in vogue is obviously inappropriate. Nor would it be safe to rely on invoices alone, unchecked by comparison with selling prices in the markets of India obtained from the Chambers of Commerce, Silk Associations, Departments of Industries and Commerce and other reliable sources.

We are convinced that the Indian Silk Industry is in greater danger to-day than it was in 1933, because it has to live against a far deadlier competition.

We are of opinion that the following measures are necessary:

(1) The import duty should be raised sufficiently to prevent foreign silk from selling in India at prices lower than the cost of production of Indian Filature silk.

The average selling price of Japanese silk to-day is Rs. 6–4–0, which would give an ex-duty price of Rs. 4–4–9. A sufficient duty on this basis would be Rs. 7–7–0 *minus* Rs. 4–4–9 or Rs. 3–2–3. Since we do not

know the trend of prices of foreign silk, it may be better to adopt a formula than to fix a specific duty. The formula may take some such form as this :

Rs. 7–7–0 *minus* ex-duty price of foreign silk *plus* (or *minus*) correction to exchange. An alternative would be a specific duty providing a margin to cover fluctuations. In this case perhaps Rs. 3–12–0 may not be excessive.

(2) The same rate of duty should be levied on silk yarn, thrown silk, spun silk and wrought silk of all descriptions.

(3) The duty on silk piece-goods should be correspondingly raised.

(4) Protection should be granted for a period of not less than ten years, to give the industry sufficient time to re-organise itself. A shorter period would not suffice as some of the measures to be taken, such as the substitution of tree for bush in mulberry cultivation, would require time to yield results, and the organisation of the industry has to be wrought out with a rural and conservative population.

(5) Indian silk should get imperial preference as it is a resource of the first importance in peace and in war.

The Japanese competition is now taking a form which bids fair to throttle the Silk Throwing Industry ; and obviously the next industry to be attacked will be hand-loom weaving. Protection to Sericulture proper is essentially protection to silk throwing and hand-loom weaving. The fact that there are about 60,000 hand-looms producing annually about 10 crores of rupees worth of goods, raises protection for silk into a measure of all-India importance.

N. Rama Rao.

International Congress of Physiologists, Zurich, 1938.

THE XVIth International Congress of Physiologists in Zurich, August 14–19, 1938, marked the 50th anniversary of the first Congress which was also held in Switzerland. Every effort was made to provide the physical equipment and surroundings necessary for the fulfilment of the purposes of the meeting and in this the Committees were uniformly successful. The space made available in the splendid buildings of the Technische Hochschule and the Universität served admirably as a setting for the scientific sessions and the discussions ; formal and informal, which are so vital a part of an international congress. Approximately 1,400 persons were registered and four-fifths of these were present. The lectures, demonstrations, and film presentations were well attended by enthusiastic groups.

At the opening session, tribute was paid to the surviving participants of the first Congress. Throughout the rest of the week eight morning or afternoon scientific sessions were held in five sections simultaneously. Of these it will only be possible to mention fields of physiology which were represented. Certain sessions, which attracted great interest, were given over to general discussions of chosen topics, beginning with special introductory addresses. These general discussions included those on the following subjects ;

Function of the parts of the renal excretory system, intermediary metabolism (role of dibasic acids, yellow ferment, free radicals), sterols, hormones, anterior hypophyseal hormones, choiinergy and adrenergy, respiratory reflexes, respiration in fetal life, function of the adrenal cortex, cell parameters, connection of local metabolism with circulatory regulation, pharmacology and the permeability of the skin to pharmaceuticals, potential poisons, nutrition, electro-acoustic analysis of speech.

Furthermore, in the regular sessions, certain subjects which received a considerable amount of attention were : heat regulation, the role of iron and protein in anemias, circulation and the circulatory system, fat chemistry and metabolism, metabolism of carbohydrates and ascorbic and pyruvic acids, muscle and nerve physiology, glandular secretion, protein chemistry and metabolism.

A business meeting at which it was voted to hold the next International Congress in England, concluded the formal programme of the week. It is safe to say that each of the participants returned home with a renewed appreciation of the part the International Congresses play in furthering the united advance in the intensely interesting and complex field of the physiological sciences.

Rollin D. Hotchkiss.

Schwann's Cell-Theory.

The Basis of One Hundred Years Investigation of Vital Processes.

By Everett White Melson.

(*Bausch & Lomb Optical Co., Rochester, New York.*)

THE cell-theory, which Theodore Schwann gave us one hundred years ago, has been followed by such a wealth of confirmation that we are justified to-day in rating it as the most fundamental concept in the whole science of modern biology. Botanist, zoologist, physiologist and pathologist study the cell in their search for the vital phenomena which take place there during health and disease.

The cell-theory has brought us, over the course of time, to some tremendous implications, involving the mechanism, the chemistry and the physiology of reproduction; further studies on the origin and evolution of species, and on those forces—both internal and external—which affect the rise and fall of racial stocks. Since evolution is essentially a change in the hereditary endowment of succeeding generations, the units of heredity are the only ones that are likely to prove useful as units of evolution.

Dobzhansky says :—

" By far the greatest achievement of genetics to date is the establishment of the fact that the hereditary materials transmitted from parents to offspring are composed of discrete particles known as genes," " Genes have their physical abode in the microscopical cellular elements known as chromosomes."

The great scope of present investigations on the cell may be traced to the work of Schleiden and Schwann, whose names have been euphoniously associated, since 1839, with the development of the cell-theory. Schwann overshadows all others, practically to exclusion, when the history of the cell concept is under consideration. Since he was a great man, however, it is not surprising to find that he acknowledges a debt to a number of men in many fields. His contribution was one of synthesis; of weaving the mass of indigestible material into a stimulating generalization.

Various candidates appear to have had just claims to having first seen the cell. To Robert Hooke, mathematician, astronomer, physicist, chemist and physiologist, is credited the first published account of the cell. This appeared in his *Micrographia* in 1665, a volume which ranged over the entire field of natural objects animate and inanimate and which, incidentally, contains the first illustration of a compound microscope, although it was invented eighty years before Hooke's observations. He might have advanced the cell concept materially if his roving genius had not shifted so continuously. Swammerdam, a Dutch investigator, saw the blood corpuscles of the frog in 1653, but his work was not published until 1738, long after his death. His description lacked the clarity of Hooke's work.

In 1661, Malpighi wrote Borelli two letters describing the air sacs in the lungs with their capillaries, and in 1670 his *Anatomy of Plants* was published containing a description of cells more accurate and significant than Hooke's. He found, according to Huxley, that the walls of the cells could be separated and he regarded them as independent entities, although they were units which coalesced to make up the plant as a whole. He called them " utriculi " or " sacculi ", mentioning them repeatedly in his descriptions of the different parts of plants and illustrating them in pictures. Malpighi was the first real histologist, both of plants and animals, corpuscles of the kidney and spleen being named after him to-day, but it is evident he regarded cells as of small importance.

Van Leeuwenhoek gave the first accurate and extensive description of the blood corpuscles in 1674, using them frequently in his work as a standard of size for minute observations. He also described the sperm, resolved some of the tissues into cellular units, and recognised the cross-striated fibrillæ of muscle. In 1759, Wolff gave proof that he saw the cells of both plants and animals, pointing to the correspondence between them. Huxley refers to Wolff's Theoria Generationis as follows :

" Wolff's doctrine concerning histological development is shortly this. Every organ is composed at first of a little mass of clear, viscous, nutritive fluid, which possesses no organization of any kind, but is at most composed of globules. In this semi-fluid mass, cavities are now developed, these, if they remain rounded or polygonal, become the subsequent cells—if they

elongate the vessels ; and the process is identically the same, whether it is examined in the vegetating point of a plant, or in the young budding organs of an animal. Both cells and vessels may subsequently be thickened by deposits from the nutritive fluid. In each case they are mere cavities, and not independent entities ; organization is not effective by them, but they are the visible results of the action of the organizing power inherent in the living mass, or what Wolff calls the ' vis essentials '."

A mass of data continued to accumulate from various men. Among these may be mentioned Treviranus, Heusinger, Prevost, Milne-Edwards, Hodgkin, Baumgartner, Arnold and Valentin. They undoubtedly saw cells and probably the nuclei of cells but the significance escaped them.

But to Rene-Joachim-Henri Dutrochet, who obtained his medical degree in 1806, at the age of twenty-nine, goes the credit for a statement of such clarity concerning the cell that he cannot be passed over in any history of the theory. Retiring from practice, broken in health, following his service as an army surgeon with Joseph Bonaparte, in Spain, he devoted himself to science, most of his papers being sent to the Paris Academy of Sciences. Although his greatest contributions were in the field of plant physiology, he made important contributions to embryology and histology.

His microscopic studies for the years 1822 and 1823 were assembled into a monograph and published in 1824 under the title :

" *Recherches anatomique et physiologique sur la structure intime des animaux et des vegetaux, et sur leur motilite.* "

From Rich's translation we learn the following :

" I must repeat here that which I have stated above regarding the organic texture of plants : we have seen that plants are composed entirely of cells, or of organs which are obviously derived from cells ; we have seen that these cells are merely contiguous and adherent to each other by cohesion, but that they do not form a tissue exactly continuous. The organic being has appeared to us, therefore, to be composed of an infinite number of microscopic parts, which are related only in proximity. Now the observations on animals which we have just described obviously confirm this view.

" In the organs of vertebrates, the globular corpuscles are so small that it is impossible to know whether they are solid or vesicular bodies ; but in molluscs that is very easy to determine. When one examines microscopically the tissue of the liver, the testis or the salivary glands of Helix or Limax, one sees that these secretory organs are composed, like those of vertebrates, of little globular bodies assembled in a confused manner ; but here these little bodies are not so excessively small. They are indeed quite large (for microscopic objects) and one can see in the clearest manner that they are vesicular bodies or true cells, the walls of which contain other very minute corpuscles. "

Dutrochet says further :

" One can therefore draw the general conclusion that the globular corpuscles which make up all the organic tissues of animals are really globular cells of an extreme smallness, which are united only by cohesion. Thus all the tissues, all the organs of animals are really only cellular tissue diversely modified. This uniformity of ultimate structure proves that organs really differ from one another only in the nature of the substances which are contained in the vesicular cells of which they are composed. All of the organic tissues of plants are made of cells and observation has now demonstrated to us that the same is true of animals. "

Dutrochet has established the anatomical identity of the cell and went on to its physiology in another passage :

" It is within the cell that the secretion of the fluid peculiar to each organ is effected. These fluids are probably transmitted by transudation into the excretory canals. Thus the cell is the secreting organ *par excellence*. It secretes, inside itself, substances which are, in some cases, destined to be transported to the outside of the body by way of the excretory ducts, and in others, destined to remain within the cell which has produced them, thus playing specific roles in the vital economy.

" In each organ the cells must have different characteristics, since such different substances are secreted within them. In this connection one cannot help admiring the prodigious diversity of the products of living beings—a diversity which is even greater in the plant kingdom than in the animal kingdom.

" What a variety in the physical and chemical qualities of the living body are organic solids ? The membrane and the shell of the bird's egg are not formed by a real growth as true organic solids are : they are formed rather by the coagulation or hardening of certain secreted fluids. Microscopic examination reveals no organic texture in such solids formed by the hardening of secreted fluids. On the other hand, whenever one finds an organic texture in the body, one can say without hesitation that that part was once alive, and that it has consequently been formed by true growth. Now an organic texture can be clearly recognised in all parts of feathers. The spongy substance is made up of a mass of globular utricles. It is true cellular or utricular tissue resembling the cellular tissue which is seen in certain parts of plants ; it is, in a way, an animal cork. "

While the phenomenon of osmosis had been observed in isolated instances, it was neither understood nor applied in any way. Dutrochet made the discovery independently and applied it in fathoming the mechanism of cellular activity. Not content with his numerous observations, clearly

set down, he was eager to apply them to physiology as noted in this statement:

"The physiological connections which I have established between plants and animals make it clear that there is but a single physiology; a general science dealing with the functions of living beings—functions which vary in their mode of execution but which are fundamentally identical in all organized beings. I hope that some day, out of these first attempts, there will be born a new science—*general physiology.*"

Certainly, as Goss says, the experiments of Detrochet made the recognition of the cell as a structural, functional, and developmental unit a necessity. Only the nucleus is left out.

It is not known whether Schwann heard Dutrochet's papers at the Paris Academy, but both men presented material through the Academy. And Schleiden, in his *Phytogenesis*, refers to Dutrochet in a foot-note.

Schleiden's claim to glory is generally considered to rest on his recognition of the fact that increase in the size and number of cells is responsible for growth. Said he,

"Growth results both from the increase in the volume of cells, and from the addition of new little cells,"

and after citing his evidence he says,

"It is evident, therefore, that during growth, new rudimentary cells are formed which, by increasing in size, finally become cells such as those which have preceded them in order of appearance and development."

Schleiden's paper on Phytogenesis, published in the same volume as Schwann's work, by the Sydenham Society, is given with such circumlocution that it is scarcely recognizable in the clearly stated abstract of it found in Schwann's work.

In the opinion of Goss, the following statement of Schleiden should divorce him completely from all connection with the cell-theory:

"The plant unfolds itself by the expansion and development of the cells already formed. It is this phenomenon especially, one altogether peculiar to plants, which, because it depends upon the fact of their being composed of cells, can never occur in any, not even the most remote form in crystals or animals."

It is difficult to comprehend how Schwann obtained the inspiration he attributes to Schleiden, unless it was a desire to disprove the categorical statement that animals could not by the remotest possibility be made up of cells. Indeed, Schwann says,

"The principal object of our investigations was to prove the accordance of the elementary parts of animals with the cells of plants."

As if the proof of likeness between plants and animals were insufficient, Schwann finished his treatise with refutation of Schleiden's statement concerning crystals using these words:

"The material of which the cells are composed is capable of producing chemical changes in the substance with which it is in contact, just as the well-known preparation of platinum converts alcohol into acetic acid. This power is possessed by every part of the cell. Now, if the cytoblastema be so changed by a cell already formed, that a substance is produced which cannot be attached to the cell, it immediately crystallizes as the central nucleolus of a new cell. And then this converts the cytoblastema in the same manner. A portion of that which is converted may remain in the cytoblastema of new cells; another portion, the cell-substance, crystallises around the central corpuscle.

"The cell-substance is either soluble in the cytoblastema, and crystallizes from it, as soon as the latter becomes saturated with it, or else it is insoluble, and crystallizes at the time of its formation, according to the laws of crystallization of bodies capable of inhibition mentioned above, forming in this manner one or more layers around the central corpuscle, and so on."

In all Schwann's work his exposition is clear. His power to make generalizations is demonstrated in this statement of his cell-theory:

"The elementary parts of all tissues are formed of cells in an analogous, though very diversified manner, so that it may be asserted, that there is one universal principle of development for the elementary parts of organisms, however, different, and that this principle is the formation of cells. This is the chief result of observations.

"The same process of development and transformation of cells within a structureless substance is repeated in the formation of all the organs of an organism, as well as in the formation of new organisms; and the fundamental phenomenon attending the exertion of productive power in organic nature is accordingly as follows: a structureless substance is present in the first instance, which lies either around or in the interior of cells already existing, and cells are formed in it in accordance with certain laws, which cells become developed in various ways into the elmentary parts of organisms.

"The development of the proposition, that there exists one general principle for the formation of all organic productions, and that this principle is the formation of cells, as well as the conclusions which may be drawn from this proposition, may be comprised under the term *cell-theory*, using it in its more extended signification, whilst in a more limited sense, by theory of the cells we understand whatever may be inferred from this proposition with respect to the powers from which these phenomena result."

During the year 1838, Schwann, in the course of conversation with Schleiden was

informed of the latter's theories of cell-formation in plants. It struck Schwann that there were many points of resemblance between animal and vegetable cells. Two circumstances contributed to the rapid and brilliant result of Schwann's subsequent observations. He made the greatest use of the nucleus in demonstrating the animal cell while emphasizing that it was the most characteristic and least variable of its constituents. Schwann, following the work of the botanists, devoted special attention to the development of animal tissues, discovering that the embryo, at its earliest stage, consisted of a number of quite similar cells. He then traced the metamorphoses or transformations which the cells underwent, until they developed into fully formed tissues of the adult animal.

He showed that while a portion of the cells retain their original spherical shape, others become cylindrical in form, and yet others develop into long threads, or star-shaped bodies, which send out numerous radiating processes from various parts of their surface. He observed that bones, cartilage, teeth, and various tissues become surrounded by firm cell walls of varying thicknesses, and finally, he explained the appearance of a number of the most typical tissues by showing that groups of cells become fused together, analogous to the development of the cell structure in plants. Schwann also studied metabolism and gave it its Greek derivation.

His materialistic view of living matter made him a scientific missionary of the first rank; his errors in observation and his conclusions in regard to the nucleus make his work seem incomplete as compared with modern cytology, but it must be remembered that he knew nothing of mitotic division and the whole science of genetics with its cytological implications was in the distant future.

Schwann led off in the great attack in which the Protoplasmic Theory was later worked out by Mohl, Cohn, Kolliker, Bischoff, Max Schultze and the physiologist, Brucke.

Hertwig-Campbell, *The Cell.*
Trend in Modern Genetics, Laughlin.
Historical Background of Schwann's Cell Theory, C. M. Goss.
Raw Materials of Evolution, Theodosius Dobzhansky.
The Cell Doctrine, J. Tyson.
The Cell Theory, Thos. H. Huxley.

The Size and Number of the Chloroplasts and the Chlorophyll Content in Eupolyploid Forms Experimentally Produced.

By Dontcho Kostoff.
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IN my previous publications[1, 2, 3, 4, 5] I have shown that eupolyploidy in plants conditions a series of hereditable changes. Some are "directed," others are not. Directed, hereditable variations in plants which show an increase with the euploid increase of the chromosomes are: (1) the amount of the nucleolar substances (number of nucleolei, size, or both), (2) the size of the nuclei, (3) the amount of cytoplasm, (4) the volume of the cells, (5) the breadth of the leaves, (6) the thickness of the leaves, (7) the size of the ovules, (8) the size of the seeds or of the grains, (9) the dark green colour of the leaves, (10) the size of the anthers, (11) the breadth of stigmas and styles and (12) the length of all kinds of trichomes. With the euploid increase of the chromosomes the vegetation period (the period between sowing and flowering) is usually prolonged. Characters like the size of the plants and the size of the flowers are also influenced by the euploid chromosome alterations, but there is no correlation between euploid chromosome alteration and the expression of these characters. In some cases the size of the plant increases with the euploid increase of the chromosomes, in other cases it decreases. The length of the flowers (corolla, calyx) vary in a similar way. The whole habitus of the tetraploids is coarser than that of the diploids.

1 Kostoff, D., *Chronica Botanica*, 1938, 4.
2 —, *Journal of Genetics*, 1938 (in the press).
3 —, *Curr. Sci.*, 1938 1938, 7, 108.
4 —, and Kendall, J. *Gartenbauwissenschaften*, 1934, Bd. 9, 22–44.
5 —, and Orlov, A. *Ann. Bot., N.S.*, 1938, 2, N. 8.

The size of the chloroplasts seems to behave differently from the characters mentioned above. This is at least true for the higher plants, especially for *Nicotiana* and *Solanum* polyploids which I have studied.

Considering the existing discrepancies upon this question we studied with Orlov[5] the size of the chloroplasts in a large number of autotetraploid and allopolyploid plants in respect to their diploid ancestors. These studies showed that all polyploids did not have larger plastids, on the contrary in a few cases there was some tendency to decrease in the size of the chloroplasts in the experimentally produced polyploids.

More recently, in applying colchicine and acenaphthene,[6,7,8] I obtained about thirty tetraploid and octaploid plants from about fifteen species and hybrids. In addition to the above-mentioned statements it was necessary to investigate the size of the chloroplasts in the octaploids that were not included in the previous studies.

I took for these studies F_1 — *Nicotiana alata* — *Sanderæ* diploid ($2n = 18$), tetraploid ($4n = 36$) and octaploid ($8n = 72$) forms obtained by colchicine treatment.

Leaves of these plants were taken and kept for about 10 minutes in tap water (in a dish) for increasing their turgidity. Then the epidermis of the under-side of the leaves was torn by breaking the leaves. Epidermis "skins" were put on glass slides on a large drop of water. I added then a drop of 2% I + KI — solution and put the cover glass. The excess of liquid was pulled out by blotting paper. In such preparations the chloroplasts were distinctly stained, so that I could count them and measure them very easily. The measurements were made by Zeiss microscope, ocular 20 and objective oil immersion × 90, one ocular micrometer division being 1·1 microns. The data obtained are given in Table I. These data show that there is no significant difference between the size of the chloroplasts in the diploid, tetraploid and octaploid plants.

What might cause then the dark green colour of the leaves of the octaploids in comparison to that of the tetraploids and diploids, and in tetraploids in comparison to that of diploids? In order to answer this question the number of chloroplasts per cell and the amount of chlorophyll per unit leaf surface were determined.

I counted the number of the chloroplasts in the stomata board cells (in both together) of the $2n$, $4n$ and $8n$ plants in preparations obtained by the above described method. Epidermis was taken from completely developed leaves, but not too old. The data obtained are given in Table II. They show that $2n$ plants had on the average 17·18 chloroplasts per a couple of stomata cells, $4n$ had 36·46 and $8n$ had 61·70 chloroplasts. The number of chloroplasts per cell vary much more in the tetraploid and octaploid plants than in diploid plants, σ being 1·79, 4·80 and 6·94 and m being 0·25, 0·73, and 0·98 in $2n$, $4n$ and $8n$ respectively.

The leaves of the octaploids had larger cells and were thicker than those of the tetraploid plants as well as those of tetraploid plants in respect to the leaves of diploid plants. I cut out equal discs (2 cm. in diameter) from leaves of $2n$, $4n$ and $8n$ plants for studying the relative amount of chlorophyll in these discs. The discs of $8n$ plants were the heaviest, then came those of $4n$ plants and finally those of $2n$ plants. The same regularities were found when the fresh material was dried. Discs of F_1 *N. alata-Sanderæ* plants, for example, of $2n$, $4n$ and $8n$ (all having a diameter of 2 cm. when they were fresh) were dried at 60° C. and weighed. Discs of the diploids weighed 9·9 mgr., those of the tetraploids 16·8 mgr. and those of the octaploids— 23·5 mgr.

For studying the relative content of the chlorophyll in this polyploid series I cut out leaf discs, 2 cm. diameter at a distance about 2 cm. from the apex from completely developed (though not too old) leaves of $2n$, $4n$ and $8n$ plants. Each disc was crushed in a mortar with 10 c.c. 96% alcohol in the following way: The disc was very well crushed in a mortar with a few drops of alcohol, then about the half of the 10 c.c. alcohol previously measured was added and then transferred for filtration through a filter-paper. The other part of the alcohol was used for washing the mortar and the pestle two times, adding each time the alcohol to the filter. The concentrations of the alcohol

[6] Kostoff, D., *Compt. Rend. Acad. Sci.*, Moscow, 1938, **19**, 189–91.

[7] —, *Curr. Sci.*, 1938, **6**, 549, 552.

[8] —, *Ibid.*, 1938, **7**, 8–11.

TABLE I.

Diameter of the Chloroplasts in Diploid, Tetraploid and Octaploid Nicotiana alata Sanderæ *Plants.*

No.	Plant chromosomes	Ocular micrometer divisions						n	M	σ	m
		4	4·5	5	5·5	6	6·5				
1	$2n = 18$	5	9	25	18	12	4	73	5·24	0·62	0·07
2	$4n = 36$	6	8	23	27	10	3	77	5·23	0·59	0·07
3	$8n = 72$	9	15	24	15	9	0	72	5·00	0·59	0·07

$M_2 - M_1 \pm m$ diff. $= 0·01 \pm 0·10$ $M_3 - M_2 \pm m$ diff. $= 0·24 \pm 0·10$ $M_3 - M_1 \pm m$ diff. $= 0·23 \pm 0·10$

TABLE II.

The Number of Chloroplasts per couple of Stomata Board Cells from Diploid, Tetraploid and Octaploid F_1 Hybrids Nicotiana Sandaræ alata.

No.	Plant chromosome numbers	Number of chloroplasts per couple of stomata board cells																		n	M	σ	m
		14–16	17–19	20–22	28–30	31–33	34–36	37–39	40–42	43–45	46–48	49–51	52–54	55–57	58–60	61–63	64–64	67–69	70–72				
1	$2n = 18$	18	29	4																51	17·18	1·79	0·25
2	$4n = 36$				3	10	12	7	6	3	1	1								43	36·46	4·80	0·73
3	$8n = 72$									1	0	3	4	2	7	10	14	5	4	50	61·70	6·94	0·98

$M_2 - M_1 \pm m$ diff. $= 19·28 \pm 0·77$; $M_3 - M_2 \pm m$ diff. $= 25·24 \pm 1·22$, $M_3 - M_1 \pm m$ diff. $= 44·52 \pm 1·01$

extracts thus obtained were measured by Dubosq colorimeter. Guthrie[9] solution was used for standard. The measurements were carried out when the standard plunger was adjusted at 5·0. Three samples were studied. The results obtained are given in Table III.

TABLE III.

Plant	Measurement in divisions			M
Diploid ($2n$) ..	18·3	17·6	16·9	17·6
Tetraploid ($4n$) ..	13·9	14·8	14·2	14·3
Octaploid ($8n$) ..	10·2	11·8	10·9	10·9

Similar extracts were prepared from dried discs after crushing and extracting them for 24 hours in 10 c.c. 96 % alcohol. The data obtained from these extractions are given in Table IV. The plunger of the Guthrie's standard solution tube was adjusted at fifth division. Three samples were studied.

TABLE IV.

Plant	Measurements in divisions			M
Diploid ($2n$) ..	21·2	21·7	20·9	21·3
Tetraploid (n) ..	17·3	16·8	17·4	17·2
Octoploid ($8n$) ..	13·8	14·2	14·9	14·3

The data given in Tables III and IV show that chlorophyll extracts of octaploid plants were most concentrated, then came the extracts of the tetraploid form and at the end, the less concentrated ones of the diploid original form.

[9] Guthrie, J. D., *Amer. Journ. Bot.*, 1928, **15**, 86–87.

I can conclude on the basis of the above reported data that the dark green colour of the leaves of the euploid forms in comparison to their original ones is due to the larger amount of chlorophyll per leaf surface unit. Leaves of polyploid plants are thicker, the thickness being due to the larger dimensions of the leaf cells. Larger cells have larger number of chloroplasts. These factors condition the larger amount of chlorophyll in the polyploid plants. The size of the chloroplasts is not responsible for the larger amount of chlorophyll in the polyploids since the euploid chromosome alterations do not lead to an increase in size of the chloroplasts, the latter being highly autonomous in respect to eupolyploid chromosome alterations.

It seems logical to postulate that the polyploid forms, having larger amount of chlorophyll, should have a greater assimilation ability per surface unit and should produce a greater amount of carbohydrates per surface unit.

An Interpretation of the Benham Colour Phenomena in Terms of the Hysteresial Augmentation Theory of Professor Burridge.

By P. S. Naidu, *Annamalai University.*

THE chromatic responses elicited by simple black and white stimuli have been studied by Fechner, Helmholtz,[1] Nicholls,[2] Bidwell[3] and others. When a disc containing black and white sectors is revolved rapidly blue and yellow rings develop very quickly. This development of coloured rings is a remarkable phenomenon in itself. But the most striking development of colours occurs in connection with the manipulation of, what is popularly known as, the Benham's Top. The striking behaviour of this revolving disc has been studied by Bidwell,[4] V. Kries,[5] Pieron[6] and Parsons,[7] and partial explanations have been given by all of them, especially by Pieron and Parsons. V. Kries admits that 'these phenomena are as yet only partially understood, and cannot be classified or positively explained'. Pieron and Parsons attempt to explain the generation of colour sensations by simple black and white stimuli as due to induction by certain spatio-temporal patterns. The latter says, 'When light falls upon the retina the luminous sensation rises rapidly and falls gradually ....It is seen that the rapidity and amount of rise of sensation varies with the intensity of the stimulus, and also with the wavelengths of monochromatic lights. The maximum is greatest with blue, least with green, and intermediate with red. It is probable that Fechner's colours seen with rotating black and white sectors, and the colours seen with Benham's Top are due to this cause.'[8]

Attempts have been made to explain the generation of colours by the well-known phenomena of contrast, successive and simultaneous. But all such explanations have been disapproved by Pieron and Parsons who show that the colours develop in monochromatic light.[9] We shall refer to this point again. Neither the 'contrast' explanation nor the 'spatio-temporal' explanation is satisfying; and so we are not surprised to find Parsons striking a disconsolate note when he concludes his discussions with the following remarks: 'Pieron's explanation of this fact is obscure and unsatisfactory. It is more probable that the true explanation depends upon reciprocal induction, but that theory also involves difficulties in time relations.'[10]

Our experiment with the Benham's Top yielded very interesting results. Instead of the usual cardboard disc, we used a circular glass disc, painted with Indian ink, as shown in Fig. 1. This was backed by a circular white board of the same diameter as the glass disc and mounted on a motor whose speed was regulated by the use of

[1] *Physiological Optics*, p. 215.
[2] *American Journal of Science*, 1884, **28**, 243.
[3] *Proc. Roy. Soc.*, 1896, **60**, 368.
[4] *Curiosities of Light and Sight.*
[5] Helmoltz, *Physiological Optics*, 2. Approved by V. Kries.
[6] *L' Annee Psychol.*, 1923, **23**.
[7] *The Theory of Perception*, Ch. xi, pp. 89-101.
[8] *Colour Vision*, p. 94.
[9] Parsons, *Perception*, p. 191.
[10] *Ibid.*, p. 192.

rheostats. In order to keep the lighting conditions constant we used a mercury vapour lamp (3 amps.) placed at a distance of 36″ from the motor. The mercury lamp

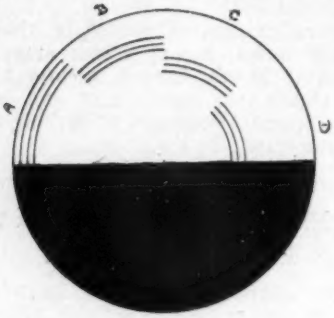

FIG. 1.
Benham's Disc.

was enclosed in a light tight box with an oblong aperture in front, covered by a milk-white glass slide, through which alone light was admitted to the revolving disc. Observations were made in a dark room through a small telescope mounted on a retort stand. Our object in using the telescope was to make it possible for us to observe only one particular set of arcs, cutting out the others, so that any influence of the latter could be eliminated. It must be mentioned at the same time that the telescope did not stand in our way when we wanted to look at the entire disc with the unaided eyes. Our observations are recorded in Tables I and II. As the results were the same when light was reflected from and transmitted through the disc, we have recorded here only one set of results. It may be noted here that the replacement of the glass disc by the usual cardboard disc makes no difference to the results.

Parsons rejects the explanations based on contrast mainly on the ground that the colours are seen even when monochromatic light is used. But we had very great difficulty in securing spectroscopically pure monochromatic sources of illumination. Even with the so-called chemical filters of light, the spectroscope revealed a wide range of colours; and with such ordinary sources of monochromatic light as the sodium flame, practically the entire spectral band is visible. It is almost impossible to get a source of pure monochromatic light (unless the spectrum itself is used as the source). The same investigator points out that 'the colours are seen only on the fine lines or on the edges of broader lines if such be used—never on the white surface'.[11] We found, on the other hand, that not only broad lines, but wide bands were completely coloured. Moreover, the white spaces acquired distinct hues—pink or green —under certain conditions.

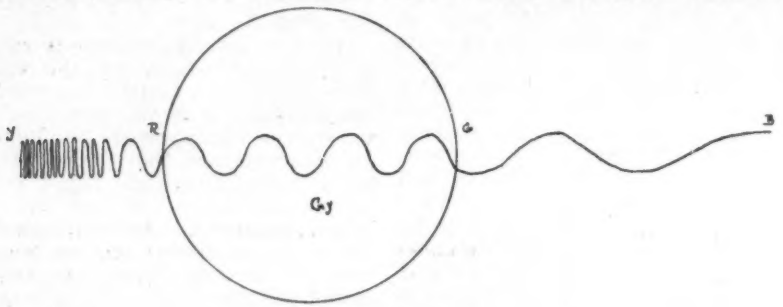

FIG. 2.

Schematic representation of the Hysteresial Hypothesis of Colour Sensation.

Augmentation. *Y*–Yellow, *R*–Red. *Gy*–Grey.

Mediated by the basic rhythm of cells. Damping. *G*–Green, *B*–Blue.

The "spatio-temporal pattern" explanation of Pieron is admitted to be the most satisfactory one advanced so far. But in his

[11] Parsons, *Perception*, p. 192.

*Colour Sensations elicited by the Benham Disc with Four Sectors.**

TABLE I.

Speed of rotation (in secs.)	A	B	C	D	Direction of rotation
0·68	violet (deep)	violet (light)	olive-green	black	↷
0·44	violet	violet	green	blue-black ?	↷
0·40	do.	olive-green	green	blue	↷
0·28	do.	do. (green most pronounced—inter-spaces green)	do.	do.	↷
0·21	reddish	green	green	violet	↷

TABLE II.

Speed of rotation (in secs.)	A	B	C	D	Direction of rotation
0·67	black	violet	violet	violet	↶
0·44	do.	olive-green	do.	do.	↶
0·40	do.	green	olive-green	do.	↶
0·29	blue	do.	do.	do.	↶
0·23	violet	do.	green	black & red ?	↶

* The observations were made by the author and by another colleague experienced in advanced spectroscopic research work Mr. N. S. Subba Rao, M.A., Lecturer in Physics, Annamalai University. Neither the author nor Mr. Subba Rao was aware of the Burridge theory when the experiment was conducted.

schematic diagram to illustrate the development of various colours in the different sectors, Pieron has recourse to the tri-colour theory.[12] This theory, we know, is based on objective colour mixtures, but has no foundation in the physiological structure of the retina. All the cones have the same structure, and so have all the rods. Edridge-Green[13] has shown that the function of the rods is to manufacture the visual purple and spread it in the fluid that bathes the cones. We are, therefore, in a quandry if we rely on any one of these multi-chromatic theories. The most satisfactory procedure is to *discard boldly all of them, and seek for a theory which will account for all colour experiences on a* Monistic *basis.* Such a monistic theory is offered to us, for the first time in the history of psycho-physiology, by Professor Burridge.[14]

The colour theories propounded so far have failed, because they have unwittingly started with the assumption that the retinal end-organs are inert structures roused to activity by light stimuli—an assumption which is not true to fact. This extraordinary assumption is the result of assuming that the living cell behaves in exactly the same manner as the muscle-nerve preparation on which the physiologist is wont to experiment with electrical stimuli. Professor Burridge says, ' The action of light on retinal end organs, is precisely that of rhythmical structures, though the due appreciation of this necessarily waited on a further knowledge of the latter's properties.... For there is producible in such structures a

[12] Parsons, *Perception*, Figs. 44–48.

[13] Edridge-Green, *Physiology of Vision.*

[14] Burridge, *Excitability, a Cardiac Study.*

specific type of augmentation, the hysteresial augmentation, of the efforts of rhythmically active retinal end-organs. There is no need for any further special hypothesis to explain the phenomena actually found.'[15]

Every cell in the living organism has a rhythmic activity of its own. The hypothesis of quiescence implicit in current physiological theories is false. The retinal end-organs have a rhythm of their own. The effect of light stimuli is either to augment or damp this inherent rhythm. Augmentation or damping may affect either one or both phases of a rhythmical activity. It may affect the amplitude or the frequency or both. In the former case brightness sensations are mediated, and colour sensation in the latter. Yellow and red are results of augmentation, green, and blue of damping, yellow and blue marking the extreme limits in either case. Grey is the fundamental retinal colour corresponding to the fundamental retinal rhythmic rate. Such in brief, is Professor Burridge's theory so far as it affects our problem.

The Benham phenomenon, which defies explanation on every other theory, lends itself to easy and simple explanation on this theory. When the disc is rotated black and white stimuli alternate in certain given proportions. The result of this alternation is either to augment the inherent rhythm of the end-organ or to damp it. The colours perceived are merely mediated by this hysteresial augmentation of the fundamental rhythm. In the case of our experiment, with the mercury vapour lamp, the result has been damping (except with the highest speed and with one set of arcs). The colours therefore range from violet to green. The damping (or augmenting) effect is due to speed variations, as the change in the direction of rotation merely changes the order of colours.

The theory is simple and true to fact. Other aspects of Professor Burridge's theory dealing with the two sources of energy, and with the nature of the interaction between these two sources have not been touched upon here. But we feel that with this new orientation in physiology many psycho-physiological problems will get solved in a very satisfactory manner.

When we compare the various theories of audition with those of vision we notice a very remarkable difference between them. In the case of the former there is no mention of different cochlear end-organs in order to account for the qualitative differences in the fundamental notes, though these differ as much among themselves as do the various colour sensations. All musical experiences are sought to be accounted for as due to the different types of response of the same kind of end-organ, whereas in the case of colour different end-organs are sought for. The reason for this is plain. The physiologist borrowed the tri-colour theory from the physicist and then attempted to twist the facts in order to make them fit with the unnatural hypothesis. What we need is complete emancipation from the misguiding influence of these multi-coloured and pluralistic theories. Professor Burridge's new physilogical psychology gives us hopes of such emancipation. We find that Benham's phenomenon is one more powerful link in the long chain of evidences adduced by the Professor in support of his new theory of hysteresial augmentation.

In conclusion, I wish to thank my colleague Mr. N. S. Subba Rao for conducting the experiment and for having made it possible for me to secure the valuable results.

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[15] Burridge, *A New Physiological Psychology*.
Burridge, "Colour Vision", *Scientia*, 1934, **56**, 141–151.

Subsoil Water Levels on the Agricultural Research Station, Sakrand.

By R. S. K. I. Thadani, M.Sc., M.Ag., and Dr. B. T. Mulwani.

EARLY in the period of construction of the Lloyd Barrage and canals project, the question of water-logging was brought very prominently to notice by the experience of the Punjab Irrigation Department. In the Punjab, water-logging has, on some older canal systems, become a very serious problem indeed and it has been necessary for the Punjab Government to set up a special organisation for the investigation of water-logging problems and to undertake many expensive drainage schemes with a view to the reclamation of water-logged or damaged lands and the prevention of further extensions of the trouble. The canal systems in the Bombay Deccan, which are fed from storage reservoirs, have also experienced a certain amount of the trouble due to the damaging, or water-logging, of lands as a consequence of irrigation from the canal systems. The experience of both the Punjab and Bombay indicated that similar trouble might be expected in Sind. This indication has led to the investigation of conditions in the areas commanded by the Lloyd Barrage canals to ascertain the possibilities of water-logging following the commencement of Barrage irrigation.

It has been now found out as a result of preliminary investigations by the Research Division of the P. W. D., that a very large area on the Right Bank (about 3,500 sq. miles) in which the predominant crop was Rice, has a high sub-soil water table. This water table is found to vary, yearly, from 3 ft. to 13 ft. below the surface of the ground, the water table being nearest the surface at the end of the irrigation (Kharif) season (*i.e.*, in October) and lowest at the commencement of the irrigation season in June.

In the other areas commanded by the Barrage, notably those on the Left Bank of the river, sub-soil water table has been found

Sub-soil water level in feet above sea-level. (*Average of readings from six bore-holes.*)

Year	Minimum Water level	Date when the minimum was reached	Maximum Water level	Date when the maximum was reached	Annual rainfall inches	Remarks
1928	70·9	27th May	73·9	17th Sept.	2·00	
1929	68·9	27th May	83·0	7th Oct.	20·36	Abnormal Floods.
1930	77·3	3rd June	86·0	16th Sept.	6·21	Floods.
1931	77·8	1st July	80·2	16th Sept.	3·45	
1932	73·5	16th June	83·5	16th Oct.	6·96	Supply of Barrage Water started from July.
1933	77·8	1st July	81·8	16th Oct.	7·00	
1934	76·2	1st July	80·2	16th Oct.	6·10	
1935	75·2	15th July	77·7	1st Oct.	4·83	
1936	74·4	1st July	76·7	1st Oct.	1·54	
1937	72·3	1st July	74·0	16th Sept.	3·82	

(*N.B.*—The ground-level is approximately 100 feet above sea-level).

to be situated at much lower levels; the problem of possible water-logging is, therefore, considered to be most urgent on the Right Bank.

It was considered necessary to know the result and effect of irrigation water, increased intensity in the cultivation and other factors like seepage, etc. (following the opening of the Barrage canals) on sub-soil water. With this object in view a series of six bore-holes had been struck right across the Sakrand Research Station in 1928. A record of the periodic fluctuations in the sub-soil water levels has been maintained since then. The maximum and minimum levels of the ground water from year to year have been tabulated above.

Examination of the data has shown so far that both the maximum and minimum levels are steadily decreasing after the rise following the supply of the Barrage water. This steady recession of the sub-soil water-level away from the soil surface is a welcome feature, on the left Bank of the Indus. Similar observations will be recorded at the Agricultural Research Station, Dakri on the Right Bank, which has just been started.

Dr. T. S. Wheeler, D.Sc., Ph.D., F.I.C., F.Inst.P., M.I.Chem.E.

THE retirement of Dr. T. S. Wheeler from the Royal Institute of Science, Bombay, is a very real loss to chemistry in India.

Dr. Wheeler possessed unique qualifications and experience as a pure and applied chemist. Educated at the O'Connell School and Royal College of Science, Dublin, he began his professional career as a demonstrator in organic chemistry at the Royal Technical College, Glasgow. He next turned to chemical industry as research chemist at the Royal Naval Cordite Factory, Dorsetshire, and later at the Research Department, Woolwich Arsenal, London. He was then appointed Senior Research Chemist to the Imperial Chemical Industries, a position rarely filled by one of Dr. Wheeler's comparative youth. The outstanding feature of Dr. Wheeler's record as a chemist is his versatility, his publications consisting of over 80 papers in well-known journals embracing every branch of pure and applied chemistry. The width of the range can be judged by his contribution to the theory of liquids on the one hand and his work on the chemistry of coumarins and chromones on the other. He was a D.Sc., a Fellow of the Institutes of Chemistry and Physics and a Member of the Institution of Chemical Engineers, an unusual array of qualifications. During the seven years that Dr. Wheeler spent in India, he established a notable position for himself in the chemical life of the country. He was responsible for the creation and development of a vigorous school of research in physical and organic chemistry in Bombay. The Department of Chemical Technology of the University of Bombay owes a great deal to the enthusiasm, initiative and general technical ability of Dr. Wheeler. As a member of the various committees connected with the creation of the Department and Vice-Chairman of the Board of Visitors, Dr. Wheeler's interest in the Department of Chemical Technology has been deep and abiding. Dr. Wheeler was prominently associated with every scientific organisation in India, being a member of the Publication Committee of the Indian Chemical Society and Vice-President of the National Institute of Sciences and of the Indian Academy of Sciences. In his departure from India, Dr. Wheeler carries with him a keen sense of regret on the part of Indian chemists that his association with them should have been prematurely terminated and every good wish for success and happiness in the new post of State Chemist in Eire, to which he has been appointed.

LETTERS TO THE EDITOR.

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Magnetic Properties of Copper Amalgams.

The magnetic behaviour of copper in dilute copper amalgams has recently elicited some controversy. One of us[1] has observed that dilute copper amalgams of low copper content are merely mechanical mixtures of the two metals and the magnetic susceptibility varies from that of pure mercury to that for pure copper. Bates and Tai[2] observed that of all the metals which are diamagnetic in the solid state, only copper retained its diamagnetic character in amalgams of dilute concentrations whereas elements like bismuth became paramagnetic. Recently Venkataramiah[3] has, however, reported that even copper becomes paramagnetic in dilute amalgams. This difference, observed in the magnetic behaviour of copper in dilute amalgams, may be due to the variations in the conditions under which the experiment might have been conducted. Therefore, amalgams were prepared under definite conditions and their magnetic susceptibilities were determined on a Gouy's balance and were checked on magnetic interference balance.

Dilute amalgams containing copper upto 3% were prepared by electrolytes. Pure mercury of $-0{\cdot}165 \times 10^{-6}$ magnetic susceptibility was used as cathode, and copper sulphate prepared from pure copper of $-0{\cdot}085 \times 10^{-6}$ magnetic susceptibility was used as an electrolyte. Pure copper sulphate from the stores was not used because even the *Analar* variety was found to contain 0·014% iron which lowered the susceptibility value of copper and consequently that of the amalgams. It was further observed that when the electrolysis was carried out at room temperatures, the solution became hot and the susceptibility values of the amalgams formed corresponded to those obtained by Venkataramiah, but when the electrolysis was done in an ice-cold solution no lowering in susceptibility value was observed. This difference may be due to the formation of such compounds as copper oxides, because copper has the tendency to get easily oxidised at higher temperatures.

Copper amalgams of higher concentration were not prepared by electrolysis because these took two to three days to be prepared, during which period they hardened and gave low magnetic susceptibility values. Therefore these were prepared by grinding the known weights of pure copper and pure mercury under dilute analytical sulphuric acid in an agate pestle and mortar. Upto 50% the amalgams when freshly prepared are fluids but amalgams of higher concentration are all solids. The magnetic susceptibility value of freshly prepared amalgams whether dilute or concentrated varies from that of pure mercury to that for pure copper. If, however, copper amalgams were kept in air, they hardened and their magnetic susceptibility values fell considerably. For example, in the case of an amalgam, containing 34% copper, the susceptibility fell from $-0{\cdot}136 \times 10^{-6}$ to $0{\cdot}071 \times 10^{-6}$ after twelve hours. If this sample was kept in vacuum its susceptibility fell to $-0{\cdot}119 \times 10^{-6}$. Chemical analysis of these samples

revealed that the hardened black and brittle sample kept in air contained 33·03% copper and the one in vacuum contained 33·98%. The fall in the percentage of copper in the sample kept in air is probably due to the formation of some oxide. Therefore, the greater fall in susceptibility of the sample kept in air seems to be due to the formation of oxide which is known to be paramagnetic. The amalgams were, therefore, kept in vacuum. In spite of this it was observed that they became brittle, their colour showed signs of fading and their magnetic susceptibility values fell from day to day till they acquired constant values. A maximum fall from $-0\cdot136 \times 10^{-6}$ to $-0\cdot047 \times 10^{-6}$ was observed in an amalgam containing 34% copper. Terry and Wright[4] have recorded a change in the crystal structure of copper amalgams on hardening and have suggested the formation of a copper mercury compound in an amalgam containing 34% copper. The fall in the magnetic susceptibility value of copper amalgams on hardening therefore is due to the change in their crystal structure and the maximum deviation at 34% is due to the formation of a compound. A detailed publication on copper amalgams will shortly follow.

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P. L. Kapur.
Girdhari Lal Mittal.

University Chemical Laboratories,
University of the Panjab,
Lahore,
November 15, 1938.

[1] S. S. Bhatnagar and K. N. Mathur, *Physical Principles and Applications of Magneto-Chemistry*, p. 341.

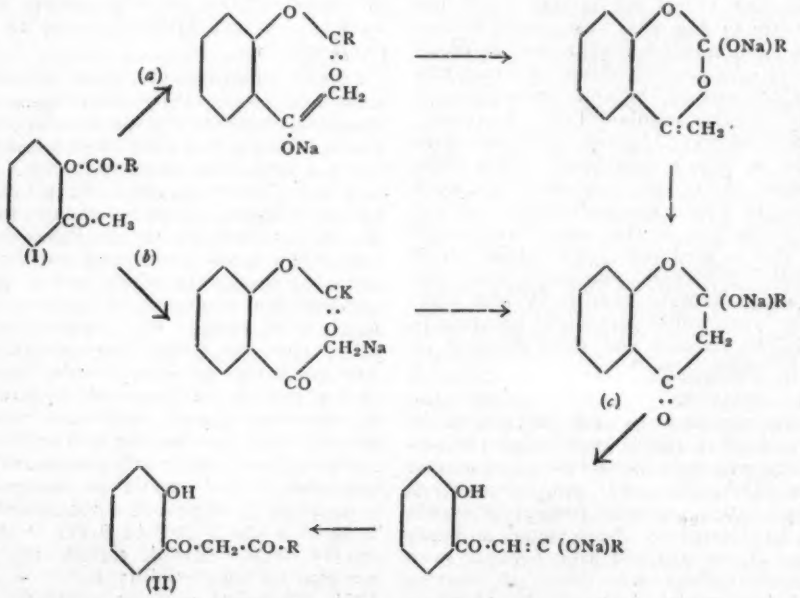
[2] L. F. Bates and L. C. Tai, *Proc. Phys. Soc.*, 1926, **48**, 795.

[3] H. S. Venkataramiah, *Proc. Ind. Acad. Sci.*, 1937, **5A**, 532.

[4] H. Terry and C. W. Wright, *Phil. Mag.*, 1928, **28**, 1055.

Preparation of Flavones from *o*-Aroyloxyacetophenones.

Virkar and Wheeler[1] showed that the Baker-Venkataraman transformation of *o*-aroyloxyacetophenones (I) into the corresponding *o*-hydroxybenzoylmethanes (II), from



which flavones can readily be obtained, could be effected with metallic sodium in ether or toluene. It has now been found that sodium ethoxide in alcoholic solution is a still better reagent for the transformation.

The fact that Claisen reagents are effective is probably significant in regard to the mechanism of the transformation, which in the presence of these reagents, may be regarded as an internal Claisen condensation proceeding *via* (*a*) or (*b*) according as we assume O-Na or C-Na formation; (*c*) corresponds to elimination of an alcohol.

V. V. Ullal.
T. S. Wheeler.

Royal Institute of Science,
Bombay, and
State Laboratory, Dublin,
November 23, 1938.

[1] *Curr. Sci.*, 1938, **7**, 107.

[2] *Cf.* Hückel, *Theoret. Grundlag. der Org. Chem.*, 1934, **1**, 215.

The Presence of Cellulase in Potato Sprouts.

Last month a peculiar case, in which certain potato sprouts bored their ways through cardboard walls of the packages used as potato containers, was observed. A careful examination of the cellulosic material of the cardboard cases showed that the material had been digested and absorbed by the sprouts as there was no indication of rupture due to mechanical force.

This observation was interesting in that the celluloses which are structural substances appear to function as storage materials also in plants. In this connection it was thought that any further evidence regarding the digestive power of potato sprouts would be highly significant. Strausbaugh[1] records a case in which a potato sprout coming in opposition with a tuber in which a wound had been made by a borer continued its growth and emerged on the opposite side of the tuber. The author emphasizes that the storage material was distinctly absorbed as there was no indication of any rupture due to mere mechanical force.

To test the digestive power of potato sprouts, 20 mg. of finely cut pieces of card-board were moistened with sterilized water and 20 ml. of 5 per cent. ammonium carbonate solution[2] was added drop by drop and thoroughly mixed. About 20 vigorously germinating tubers were washed first with mercuric chloride solution (1 : 1000) and then with sterilized water and 1–2 fairly big sprouts together with some potato tissue from the bud-end of each tuber were cut and placed in the flask containing the card-board + ammonium carbonate suspension. Some more sterilized water was added and the flask plugged with sterilized cotton wool and was incubated at 30° C. for 17 days. Portions of the cardboard material were taken out at 3-day intervals and analysed for cellulose content by the Norman and Jenkins[3] modification of Cross and Bevan[4] procedure. Xylan was also estimated on isolated cellulose samples. Xylan content is obtained from the furfuraldehyde yield of the isolated cellulose by reference to Krober's tables. Furfuraldehyde yield was obtained by distillation with 12 per cent. HCl and precipitation as phloroglucide. The data obtained in this connection are presented in Table I.

Table I.

Decomposition of Cellulose by Potato Sprouts.

Time Interval days	Cellulose content gms.	Xylan content gms.
0	12·72	3·23
3	12·01	3·02
6	11·78	2·78
9	11·01	2·47
12	10·87	1·88
15	10·78	1·30

It is evident from the data that a greater percentage of loss in cellulose is attributable to the loss of xylan—a cellulose which is associated with most celluloses. It appears that xylan, being in all probability, less

resistant than cellulose, is mainly, digested by potato sprouts.

B. N. SINGH.
P. B. MATHUR.
M. L. MEHTA.

Institute of Agricultural Research,
Benares Hindu University,
August 18, 1938.

[1] Strausbaugh, *Plant Physiol.*, 1929, **4**, 157.
[2] Hutchinson and Richards, *J. Min. Agr.*, 1921, **28**, 308
[3] Norman and Jenkins, *Biochem. J.*, 1933, **27**, 818.
[4] Cross and Bevan, *Cellulose* (London), 1918.

Green-Seeded Gram (*Cicer arietinum* L.) in Central Provinces.

AN exhaustive collection of local grams from all over the Central Provinces and Berar is in progress at the Oil Seeds Research Station, Nagpur. In the samples collected so far, a new type of gram was noticed. It is chiefly characterised by the presence of variable grades of green coloured seed-coat. This gram is reported to have been observed in 1932–33 by one Laharia, a cultivator of the village Bagaspur in Narasinghpur Tahsil, C.P., in a field of D 8 gram (*Gulabi Chana*). Subsequently it was tried on a large scale by one Choudhary Moolchand of Gotegaon and since then the area under this gram has been rapidly increasing due to a very high price it fetches in the market. The estimated area in 1936–37 has been reported to be 1,500 acres in that tract.

During the year 1937–38 this type was tried at the Government Experimental Farm, Adhartal. The seeds obtained bred true in respect of the various grades of green seed-coat. A few seeds of this type were sown during the rainy season of the current year for some experimental purposes at the Oil Seeds Research Laboratory and were observed to be breeding true. The plants were harvested when fully matured and the seeds obtained were healthy and showed cent. per cent. germination. The green condition, therefore, does not represent an early stage of maturity of any gram type.

The chromosome counts were made from the root-tip cells which showed $2n = 16$ (Fig. 1). In temporary aceto-carmine preparation eight bivalents were clearly observed at I metaphase in polar view. chromosome number in this species has been

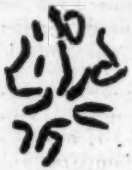


FIG. 1.

Somatic chromosomes in green-seeded gram (*Cicer arietinum* L.). $2n = 16$.

reported to be $2n = 14$ by Rau.[1] Dixit[2] studied the chromosomes of the Pusa types 1, 2, 18 and 25; in the first two types (the "Kabuli" gram types) the chromosome number was observed to be $2n = 16$ while the remaining two (the "Deshi Gram" types) showed $2n = 14$. In a giant mutant form of type 22 the chromosome number was recorded as $2n = 16$ by Dixit.[3]

The senior author is indebted to the Imperial Council of Agricultural Research for financing the Oil Seeds Research Scheme, Nagpur, where this work is being carried out.

R. H. RICHHARIA.
R. J. KALAMKAR.

Oil Seeds Research Laboratory,
Nagpur,
November 8, 1938.

[1] Rau, N. S., *Jour. Ind. Bot. Soc.*, 1929, **8**, 201–206.
[2] Dixit, P. D., *Ind. Jour. Agri. Sci.*, 1932, **2**, 385–390.
[3] Dixit, P. D., *Ibid.*, 1932, **2**, 391–408.

On the Occurrence of *Isarachnactis* in the Arabian Sea.

EARLY in 1935, Mr. S. Jones, of Trivandrum handed over to me a small collection of a certain larval Cerianthid which he obtained in August 1933, from the neighbourhood of Kovilam on the Travancore coast. Detailed study of these specimens could not then be attempted owing to other preoccupations. Recently, I have obtained specimens of the same form collected off the coast of Alleppey and Ambalapuzha in Travancore, and with the material gathered from the three localities, I have been able to make a fairly complete study of the anatomy of this interesting Cerianthid,

from serial sections as well as dissections of the specimens.

These Cerianthids are from 20 to 30 mm. long (inclusive of the tentacles) and from 4 to 6 mm. broad; and they are of an yellowish brown colour in the preserved state. In the earlier stages, the tentacles are almost as long as the body, and occasionally even longer, but in the older stages the column is comparatively more prominent. There are both marginal and oral tentacles; the latter are much smaller than the marginals and occur close to the stomodæal opening. The directive and the two adjoining chambers are provided with oral tentacles.

In view of the absence of botrucnidæ and the occurrence of acontia, the larvæ belong to the family Arachnanthidæ and they have the general appearance of *Dactylactis* and other allied genera. The presence of oral tentacles corresponding to the early protomesenterial chambers, definitely indicates that the larvæ in question belong to the genus *Isarachnactis* Carlgren. This fact is also borne out by other anatomical details like the structure of the syphonoglyph, the nature of the mesenteries, and origin and position of the acontia.

The genus *Isarachnactis* is known from two species, *I. lobiancoi* (originally described as *Arachnactis lobiancoi*) from the gulf of Naples[1] and *I. longipes* obtained by the German Deep Sea Expedition from the neighbourhood of Gibralter.[2] The genus is so far known only from the Mediterranean, and its occurrence in the Arabian Sea, as far down as the Travancore coast, is an interesting new information in connection with its distribution.

Detailed accounts of the anatomy and systematics of this interesting Ceriantharian will be published elsewhere.

N. Kesava Panikkar.

Madras Christian College,
Tambaram, and
Department of Zoology,
University of Madras,
December 2, 1938.

[1] Carlgren, O., "Über Ceriantharien des Mittelmeers." *Mitt. Zool. Stat. Neapel*, 1921, **Bd. 20**, 356–394 and Pl. 15–17.

[2] Carlgren, O., "Die larven der Ceriantharien, Zoantharien und Actiniarien," *Wiss. Ergebn. Deutschen Tief. See Expedition, Valdivia*, 1924, **Bd. 19**, Hft. 8, 341–475 and Pl. 1–6.

The Chromosome Complements in Eight Species of Locustidæ.

We have investigated the chromosome complements of eight species of Locustidæ mentioned in the following table. The specimens from which testes were dissected out and fixed were collected from two localities, near Gujarat College, Ahmedabad, North Gujarat and Jogeshwari about 20 miles north of Bombay. Both these localities are situated in the Bombay Presidency, Western India. The accompanying table also contains the main particulars, namely the diploid number, the number of V-shaped elements and the X-chromosome as shown in the accompanying figures of the spermatogonial complexes of the species investigated.

Table.

	Diploid chrom. Number	No. of V's contained	Shape of X-chrom.
Subfam. Phaneropterinæ			
1. *Ducetia japonica* ..	29	..	R
2. *Elimæa securigera* ..	27	1	V
3. A sp. of Phaneropterinæ	31	..	R
Subfam. Mecopodinæ			
4. *Mecopoda elongata* ..	27	5 (at least)	V
Subfam. Pseudophyllinæ			
5. *Sathrophyllia* sp. ..	35	..	R
Subfam. Conocephalinæ			
6. *Conocephalus* sp. ..	33	5	V
Subfam. Listroscelinæ			
7. *Hexacentrus mundus*	31	1	V
8. *H. annulicornis* ..	(31)	1	V

R = rod-shaped chromosome: V = V-shaped chromosome.

In *Hexacentrus annulicornis* (No. 8), the diploid number is inferred from the haploid condition observed in the primary spermatocyte.

In every species studied the sex-chromosome, the x-element is either V-shaped or has

the form of a rod. And in the first spermatocyte division this X-chromosome exhibits a

FIG. 1.
Ducetia japonica.

FIG. 2.
Elimæa securigera.

FIG. 3.
A species of *Phaneropterinæ.*

FIG. 4.
Mecopoda elongata.

FIG. 5.
Sathrophyllia sp.

FIG. 6.
Conocephalus sp.

FIG. 7.
Hexacentrus mundus.

All are from spermatogonial metaphases, × 1500.
x: X-chromosome.

conspicuous precession by running towards the pole of its side ahead of other autosomes in course of separation. This seems to be a remarkable characteristic of the chromosomes of the Locustidæ in comparison to those of the Acrididæ, as in the latter group this behaviour of the X-chromosome of primary spermatocytes in division is not so marked.

In other respects too the Locustid chromosome complements show a marked contrast to those of the Acrididæ. The former group displays a wide range of variety in the constitution of its chromosomal garniture even among the members of the same sub-family, while in the Acrididæ the chromosomal complements do not deviate much and are more or less uniform in the various sub-families.

A full account of these observations will be published elsewhere.

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Gujarat College, Ahmedabad,
and Hok. Imp. Univ., Japan.
December 1, 1938.

A Note on Gametogenesis in a Few Members of *Sterculiaceae.*

LITERATURE on the members of *Sterculiaceæ* is very scanty, but for the works of Cheesman (1927), Kuijper (1914), and Heyn (1930), on *Theobroma Cacao*, and Gioelli (1932) on some European species like *Brachychiton acerifolium*. The following is a short account on the gametogenesis of a few members of the family, namely, *Pterospermum reticulatum* W. and A., *P. heyneanum* Wall, *P. acerifolium* Willd., *Sterculia acerifolia* A. Cunn., and *Helicteres isora* L. The detailed paper will be published elsewhere.

The ovules have two integuments in all, and in *Helicteres isora* the nucellus is exposed due to the incomplete development of the two integuments (Fig. 1).

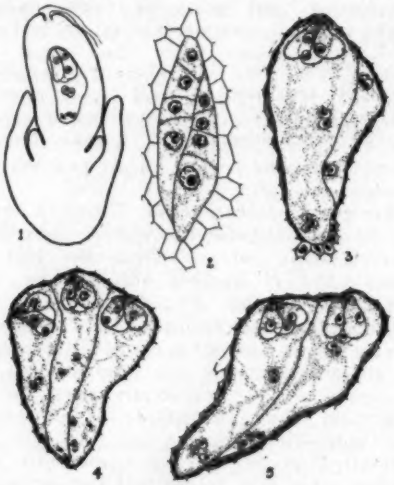

FIG. 1.—Ovule of *Helicteres isora* at the time of fertilization. × 266·7.

FIG. 2.—Double tetrads of megaspores in *Pterospermum acerifolium.* × 600.

FIG. 3.—Double embryo-sacs in same. × 266·7.

FIG. 4.—Triple embryo-sacs in same. × 186·7.

FIG. 5.—Double embryo sacs in same. × 266·7.

(Original magnifications are indicated; reduced in reproduction to approximately one-third.)

The primary archesporium is hypodermal in origin and consists of a single cell in *Sterculia acerifolia* and *Helicteres isora*, and a

number of cells in the species of *Pterospermum*. A number of parietal layers are formed and the megaspore-mother cells become deeply situated in the nucellus. Only one megaspore-mother cell is functional in all except in *P. acerifolium*, where two or three develop further. The formation of a linear tetrad has been observed in all. In *P. acerifolium*, due to the activity of two or three megaspore-mother cells, more than one tetrad is formed (Fig. 2).

The usual course of development follows and the normal eight-nucleate embryo-sac is formed. Gioelli (1932) working on some members of Sterculiaceæ, reports the occurrence of six-nucleate embryo-sacs, but such a case has not been found in any of the plants studied now. In *Pterospermum acerifolium* the multiple tetrads develop into double and triple embryo-sacs (Figs. 3, 4 & 5). The occurrence of double and triple embryo-sacs is reported for the first time in the family.

Meiosis in the microspore mother cells of *Sterculia acerifolia* and *Pterospermum reticulatum* has been studied and the haploid chromosome number in both is nineteen.

The author expresses his sincere thanks to Dr. M. A. Sampathkumaran, M.A., Ph.D., and Prof. L. Narayana Rao, M.Sc., F.R.M.S., for suggestions and guidance.

Y. M. Lakshminarayana Sharma.

Department of Botany,
Central College,
Bangalore,
December 3, 1938.

Cheesman, E. E., "Fertilization and embryogeny in *Theobroma Cacao*," *Ann. Bot.*, 1927, **41**, No. 161.

Gioelli, F., *Contributo Alla Conoscenza Del Gametofito Femmineo E del Polline Nella Famiglia Delle* Sterculiaceæ, 1932.

Heyn, A. N. J., "Die Befruchtung bei *Theobroma Cacao*," *Proc. Akad. Wet. Amsterdam*, 1930, **33**, 533–41.

Kuijper, J., "Die Entwicklung des Weiblichen Geschlechtsapparates bei *Theobroma Cacao*" (*Rec. trav. Bot. Neerl.*, 1914, **11**, 37–43).

Albinism in Mustards.

Mustard work has been in progress for the last six years, and there are 132 strains isolated from different species of cultivated Brassicas—*Brassica juncea* H.F. and T. *Brassica campestis* L., *Brassica Napus* L., *Brassica nigra* Koch, *Brassica rugoja* Prain. A few albinatic plants appeared this year for the first time. It was interesting to find that these were confined to one strain of the lines of *Brassica Napus*. Cotyledons in these palnts are normal and green while the subsequent leaves are completely albinatic and much reduced in size. The plants on the whole are very delicate. If they survive and are able to give some seed, it will be interesting to study the inheritance of this character in their offsprings.

T. S. Sabnis.

Cawnpore,
November 19, 1938.

Gynura crepidioides Bth. in China and Hainan.

The record of this vigorously spreading weed from the mainland of Asia,[1] has been recently extended by Bor[2].

Among a collection of duplicates recently received at Buitenzorg, I found specimens of *Gynura crepidioides* Bth. which represent—as far as I know—the first appearance in China and Hainan, both collected in 1935. In the preliminary identifications it was mistaken—as is often the case in herbaria—for *Erechthites hieracifolia* Rafin..

The localities are the following:

China. Hunan Prov.: Ma-Ling-Tung, Sinning Hsien, Oct. 16th, 1935, C. S. Fan Y. V. Li No. 618, herb 2–3 feet tall, along shaded streamside, 600 m. alt.

Hainan. Po-ting, April 1935, F. C. How 71591, herb on roadside flowers red.

C. G. G. J. van Steenis.

The Herbarium, Botanic
Gardens,
Buitenzorg, Java,
November 15, 1938.

[1] *Curr. Sci.*, 1938, **7**, 21.

[2] *Ibid.*, 1938, **7**, 116.

REVIEWS.

The Chemical Studies of P. J. Macquer. By Leslie J. M. Coleby. (George Allen & Unwin, Ltd., London), 1938. Pp. 129. Price 6*s.* net.

Dr. Coleby's admirable contribution to the History of Science Library edited by Prof. A. Wolf, gives a happy picture of the discerning and industrious French chemist, Pierre Joseph Macquer (1718–84), whose eminence was recognised by his contemporaries more clearly than by the present generation. The reason for this may possibly be the fact that, although dying only ten years before Lavoisier was beheaded, Macquer remained a phlogistonite, believing that phlogiston was combined light, instead of combined fire as held by G. E. Stahl (1660–1734) developing the views of J. J. Becher (1635–82).

He was one of the first chemists who observed the formation of water when hydrogen is burned (before October, 1776), but even in 1778 still considered water, along with air, fire and earth, to be the only elementary substances. He took the Newtonian view of heat as a state of rapid motion among the ultimate particles of a hot body. He was the first to isolate arsenic acid (before 1766), although the credit for this has always gone to Scheele (1775). Succeeding Hellot as director of the dyeing industries, Macquer made valuable contributions to the practice of this art, and had clear views regarding its underlying principles, recognising that the purely mechanical theory of Hellot was insufficient to explain the facts. As director of porcelain manufacture at Sèvres, also in succession to Hellot, he emulated J. H. Pott (1692–1777) who was employed by the King of Prussia to ascertain the constituents of Meissen ware, improving Pott's furnace, and conducting a ten years' course of laborious experiments which led, in 1769, to the perfect porcelain.

Macquer's great contribution to science, however, lay in his *Dictionnaire de Chymie*, first published in 1766, and appearing as a greatly augmented revised edition, occupying four volumes octavo (over 2,000 pages) in 1778. During his life-time the fabric of chemistry had completely changed, and the dictionary finally dispelled any lingering mists of alchemy: it was preceded by his *Elémens de Chymie Théorique* (1749) and *Elémens de Chymie Pratique* (1751), superseding Lemery's *Cours de Chymie* (1675), a practical handbook of preparative pharmacy. The dictionary was a chemical best-seller, the first edition undergoing translation into German (1768), Danish and English (1771); whilst the second edition was translated into German (1781–83) and Italian (1783–84). The chemical foundation of the first edition was phlogiston, and at the revision closing in 1776 Macquer was called upon to decide whether he could accept the new ideas of Lavoisier. He chose a dispassionate compromise, the strictly non-committal aspect of which is condensed in the following quotation from the Preface .... "None of thep ropositions....which I myself indicate as principles, because of the great many facts which support them, must be taken as literally or necessarily true." How different would be the complexion of our lives if political champions were equally detached.

Many of Macquer's researches were published in the Memoirs of the Academy, and the remainder incorporated in the dictionary: among the former will be noted by the curious a contribution on "white gold" or platinum, one pound of which had reached Baumé from a friend in Madrid (1757). The source of this windfall was Mexico, and the two chemists interested themselves in its properties. The Spanish Government had placed an embargo on its production and export because it could be used for debasing gold, and in 1788 were buying platinum at eight shillings a pound, presumably for that purpose.

The current generation has witnessed advances in chemical science as dramatic as those of any other period, and involving profound alteration of chemical outlook. It is restful and informative to review the more leisurely mental processes of the eighteenth century, and the present estimate of a colleague and older contemporary of Lavoisier, for which gratitude is due to Dr. Coleby, is carefully planned and agreeably presented.

M. O. F.

Annual Review of Biochemistry. Vol. VII. Edited by James Murray Luck (Annual Reviews, Inc. Stanford University, P.O. California), 1938. Pp. vii + 571. $5·00.

Biological chemists all the world over eagerly await with keen interest the appearance of this Annual Review and have become accustomed to find contributions relating to the most outstanding topics of the day, critically appraised by the foremost exponents in the field. The present volume fulfils these expectations to a generous degree.

The Editors have been fortunate in securing the services of some of the ablest men for reviewing the topics and this success is largely due to the untiring efforts of Dr. Luck who, often, takes a trip to Europe with the object of establishing personal contacts with all the possible reviewers.

When there is so much, which is excellent, it is difficult and perhaps invidious to discriminate. But we feel tempted to invite attention to the appropriateness of an article by Lohmann on the chemistry and metabolism of the compounds of phosphorus closely following his brilliant discovery that co-carboxylase is diphosphorylated vitamin B_1. It is indeed thoughtful of the Editors to have arranged for having a contribution on Vitamin-B Group by Peters and his colleagues, who had long established an intimate connection between vitamin B_1 and the decarboxylation of pyruvic acid.

The chemistry of amino-acids and proteins is reviewed by Bergmann who has substantially contributed towards the elucidation of the structure of proteins. Authoritative is the contribution of Mitchell on nutrition and so are those of Boysen Jensen on the growth regulations of plants, of Krebs on the metabolism of amino-acids and proteins, and of Lundsgaard on the biochemistry of muscle.

Newer Methods of Volumetric Chemical Analysis. By Erna Brennecke, N. Howell Furman, Hellmuth Stamm, Rudolf Lang and Kasimir Fajans. Wilhelm Boettger, Editor. Translated by Ralph E. Oesper. (Chapman & Hall, Ltd., London), 1938. Pp. xiii + 268. Price 18/6.

As the title suggests, the book is a symposium on new methods of volumetric analysis in which are dealt with, in seven parts: (1) Elimination of titration errors, (2) Ceric sulphate as oxidizing agent, (3) Alkaline permanganate titrations, (4) Iodate and bromate methods, (5) Chromous solutions as reducing agents, (6) Oxidation and reduction indicators, and (7) Adsorption indicators. Each of the sections is written by an authority on the subject. According to the Editor the topics have been treated with two objectives in mind: (*a*) exposition of the theory underlying the new method, so that an insight may be gained into the reasons for the way in which the subject has been developed, and (*b*) the presentation, so far as possible, of an exact set of directions for the performance of particular analysis. It may be pointed out that the book is not meant for a beginner, and is not meant to supplant existing textbooks on volumetric analysis. Only an analytical chemist, who is conversant with existing processes, can follow these newer methods with benefit.

As most workers are aware, ceric sulphate as an oxidising agent is a serious rival to potassium permanganate. The chief advantages claimed for ceric sulphate are, firstly, its stability even at boiling temperatures; secondly, that it can be titrated in presence of HCl, and thirdly, the simplicity of its reduction product, *viz.*, $Ce^{++++} \rightarrow Ce^{+++}$. Even though in some cases, for example, organic acids (p. 46), the stoichiometric relations do not hold good, to practical chemists the result matters most, and so long as that is satisfactory, the theoretical aspect is only of secondary importance.

Similarly, recognition is sought for chromous solutions as against titanous, as reducing agents for potentiometric titrations. The reducing power of Cr^{++} is very much greater than that of Ti^{+++}. (The normal potentials of the two are $-0·41$ volt and $-0·04$ volt respectively.) This excellent property from the theoretical point of view has its drawbacks in practice; chromous solutions are very sensitive to atmospheric oxygen and so should be prepared and stored with extreme care, and titrations should be carried out in an atmosphere of CO_2. The necessary directions are given in detail.

The critical discussion of the behaviour of a number of "Redox" (presumably an American abbreviation for "reduction-oxidation") indicators should be extremely helpful to every student of chemistry, theoretical and practical. Similarly the

numerous applications of the various processes compiled at the end of each section will be welcomed by all analysts.

The final chapter on adsorption indicators is refreshingly new, and is treated in the lucid style of Prof. Fajans, who was the originator of this method of volumetric work. First developed by him in 1923, it has attracted a number of workers, and more than 60 papers have appeared since then, including five from India. The author himself points out that these indicators do not always indicate the exact equivalence point, and hence can only be of limited application. In the case of single radicals, for example the halides, the method is very good, while mixtures give trouble, and the experimental conditions have to be carefully worked out. This chapter would have been more helpful if fuller details had been given of experimental conditions for each estimation. The Bibliography is comprehensive enough, but not every worker has immediate access to the original literature.

The book is to be welcomed as a useful supplement to existing works of reference, and may be regarded as an excellent contribution to the recent advances in volumetric analysis.

M. R. N.

The Fundamental Principles of Quantum Mechanics, with Elementary Applications. By Edwin C. Kemble. (McGraw-Hill Publishing Company, Ltd., London), 1937. Pp. 611. Price 36*s*.

Within the brief space of a decade the science of Quantum Mechanics has grown rapidly due to the united labours of mathematicians and physicists, and now bids fair to oust the classical ideas from the field of Physics. Though we have to thank the Institution of Physicists for its basic ideas, a really satisfactory presentation and a rigorous formulation of the whole subject now require mathematical methods of the type unfamiliar to most students of Physics. Nor can it be said that all the uncertainties and the dark corners have been completely cleared up and illuminated by the mathematicians. In spite of the attempts of the various physicists, it is difficult, nay even impossible, to clothe the fundamental ideas of the new mechanics in a language familiar to the classical physicists. The genial idea of the wave-packet alluring in the first instance has come out insufficient on closer analysis, and though a statistical interpretation of the wave-theory seems to be the only one satisfactory from the philosophical standpoint, the methods of this new Statistics are not the same as those of the classical kinetic theory. It is also desirable that the beginners should be made aware of the defects that still exist in an otherwise imposing structure, and attempts should be made to familiarise the students of Physics with the abstruse mathematical ideas of Neumann and Dirac, by presenting the main outlines of the subject in a compact and attractive form.

The regrettable tendencies in most text-books of the subject to gloss over difficulties, have induced the author to write a text-book which aims at a rigorous formulation of the fundamental principles, and tries to explain at length all the novel mathematical ideas, essential for a proper understanding of the subject. The book begins with a historical introduction and gradually leads up to modern statistical ideas: Typical problems of wave-mechanics are worked out at length to illustrate the peculiarities of the new method and the reader is familiarised by easy stages with the idea of orthogonal functions, and with operational methods. The author has taken every care to explain all novel ideas, and it is hoped that the beginners who work through Chapter IV of the book will master the essentials of the new analysis. The fundamental problem of the hydrogenic atom, and of the diatomic molecules are next dealt with at great length, which thus prepare the reader for a proper appreciation of the extension of the method to the many particle problems. The author has devoted a considerable portion of the book to familiarise the reader with the operator-method of Von Neumann. Neumann's own book on the subject is too difficult for any but the most mathematical; nevertheless it is necessary that the physicists should be familiar with the basic ideas of his mathematical theory, in order that he may appreciate how the philosophical difficulties of the subject are attempted to be removed.

The matrix methods, and the theory of perturbation are also treated at some length, and the book ends with an introduction to the theories of the electron-spin, the many

electron-problems and to the exchange phenomena.

The Appendix contains a good deal of mathematical material which will minimise a too frequent consultation of mathematical reference books. However for the benefit of his more curious readers, the author has also given numerous references to original papers which deal with the matter in more detail.

The author is to be congratulated on having thus tackled a formidable task in an eminently satisfactory fashion. Like most of the other useful books of the international series in Physics, it removes a long-felt want, and will help the cause of Physics by making an abstruse but important subject attractive and readable by a masterly exposition. S. N. B.

The Principles and Practice of Lubrication. By A. W. Nash and A. R. Bowen. (Chapman & Hall, Ltd., London), 1937. Pp. 345. Price 18*s*. net.

This book, as its name implies, deals with the principles and practice of lubrication. There is hardly any machine or mill the success of which is not partly dependent on lubrication. For successful lubrication, science is going to play even a more important part than it has hitherto done. It is not only the design and composition of bearings, essentially engineering problems, but the characteristics of oils and the mode of their applications which physico-chemical investigators must determine, that will help in the definition and the solution of the much vexed question of 'oiliness'.

The contents of this book have been divided into ten chapters:

(1) Introduction.
(2) Friction.
(3) Specific Gravity and Viscosity.
(4) Design and Lubrication of Bearings.
(5) Source of Lubricants.
(6) The Chemistry of Lubricants.
(7) Chemical and Physical Tests for Lubricating Oils.
(8) Industrial Lubrication Practice.
(9) Mechanical Friction Testing Machines.
(10) The Care of Lubricants.

There is an appendix which provides some useful physical data and tables and a subject index. The absence of a separate name index is not particularly noticeable as unfortunately this book does not deal with the subject in a historical manner nor has it aimed at giving the most recent information on the subject which is available in literature. The high pressure lubricants which are attracting a great deal of attention, particularly in America, have hardly been described. The book is particularly weak from the point of view of theory.

The chapter on the design and lubrication of bearings is well written and the book presents all that is generally known to the chemists working in the oil of refineries. It has tried to add very little new to the stock of their knowledge from modern publications. The chapter on sources of lubricants contains valuable information and helps in understanding the part which solvent refining plays in obtaining a good lubricant.

The book will prove of great help to those who wish to be acquainted with the general principles of lubrication without having to go into greater details. The reviewer has no doubt that the new edition will aim at a more ambitious production and if the theory and the mathematical portions are extended and the recent work on high pressure lubricants is more fully dealt with, this book will become one of the important publications in the oil literature which has been greatly enriched by the work of Ellis and Dunstan and his collaborators during recent yeers. The get-up of the book and the presentation are good. S. S. B.

Eugen Jahnke and Fritze Emde.—Table of Functions with Formulæ and Curves. By B. G. Teubner. (Leipzig and Berlin), 1938. Third (Revised) Edition with 181 Figs. Pp. 305. Cloth R.M. 15—less 25% abroad.

This wonderful book of tables whose text is written in two languages, German and English, side by side, is now in its third edition. The first 78 pages of the second edition have now been deleted. The author (Mr. Jahnke, the original joint author, is now not living) has felt that these pages comprising the tables of the more elementary functions should not appear along with the tables of the higher functions, and he promises to bring forth a separate book for these elementary functions. The present edition is however smaller than the second edition only by 25 pages, showing that more than 50 pages of extra matter have now been introduced. The chief additions are in the tables relating to the

complete elliptic integrals of the first and second kind wherein tables have been added for other than the Legendre forms, and in the tables relating to the Weber-Lommel and Struve's functions. Also, formulæ and graphical representations are given for the confluent hypergeometric functions and for Mathieu functions.

It will be presumptuous on my part to describe the salient features of "Jahnke-Emde Tables of Functions" which by now must have forced its attention on every student of function theory. It is, no doubt, true that the usefulness of the Tables will be most appreciated by practical computers whose work involves these higher mathematical functions. But every student and teacher of the theory of functions must now realize that his study of the subject must include besides the formal analytical development, a proper grasp as regards the exact graphical and pictorial conception of these functions. To quote from the Preface of the previous edition, "In every text-book of differential calculus it is regarded as essential to illustrate the nature of simple functions in the real domain by means of curves". The most important contribution of the book, so far as pure mathematicians are concerned, is in its opening their eyes to show that such a process is equally desirable in the study of functions in the complex domain.

C. N. S.

Charts for Design of Timber Beams. By V. M. Limaye. (Published by the Forest Research Institute, Dehra Dun), 1938.

The charts prepared by Mr. V. M. Limaye will be very useful for engineers who are called upon to design structures out of timber. As again timber seems to be becoming more and more popular, these charts will be of considerable help to designers as the dimension for the beams can be arrived at easily in a few seconds, thus saving time and labour. It would have been more interesting if the author had given a short note on the formulæ used and on the construction of the charts themselves.

These charts should find a place in the library of every building Engineer.

E. K. R.

Text-Book of Biology. By C. J. George, Wilson College, Bombay. (Published by the Author), 1938. Price Rs. 7–8.

With the introduction of the Bifurcation Scheme by the Bombay University whereby the student takes either a Science course or an Arts one from the very first year of his College career, a good number of books on Biology by different teachers in the Colleges affiliated to the Bombay University have appeared. Many of them are scrappy, badly brought out and full of mistakes. These faults are due either to the haste with which they were brought out or due to the lack of capacity of the authors to write them properly.

As such, it is a pleasure to find occasionally a book on Biology which is well written, nicely printed and handsomely brought out at a comparatively low price of Rs. 7–8–0. Such is the book of Dr. George which combines in it several advantages over other Indian text-books on Biology and I commend it both to teachers and students of the Bombay University.

This is perhaps the first Indian text-book which deals both with Botany and Zoology courses for Intermediate Science Course. This is a distinct advantage to the student in that it costs him less. Within the short space of 440 pages the author has very successfully covered both the Botany and Zoology courses for Inter Science Examination and even added two more chapters on Heredity and Organic Evolution. Thus the book is a very comprehensive work and we may say that the author has practically left nothing untouched, or that could be desired for an elementary student of Biology. Another important feature of the work is that the author has added personal observations, on Yeast, Moss, etc. Not only this but he has included separate sections on physiology wherein he leads the reader to the study of biochemical changes occurring in the germination of seedlings.

In the end, however, may be mentioned two faults: (1) the figures in the chapter on Plant Physiology which on the whole are very good, are badly drawn; (2) a chapter on Plant Ecology would greatly enhance the value of the book. We congratulate the author on his achievement and wish that many more such comprehensive books would be published by the author.

F. R. B.

The Indian Sugar Industry (1938 *Annual*). By M. P. Gandhi. (Gandhi & Co., Calcutta), 1938. Pp. 300. Price Rs. 2–4–0.

This publication like its predecessors by the same author, abounds in statistical information about the progress of Indian Sugar Industry during the year 1938. The data are presented alongside the corresponding figures for the previous years and enable the reader to make a thorough comparison.

The essential texts of the various Acts of the Government of India and the Provincial Governments of the U.P. and Bihar, relating to the protection and control of Sugar Industry are given in the beginning of this monograph. Following this is a compilation of 37 tables—Sugar Industry at a glance—containing numerous industrial data. This is a very useful and ready reference for the readers. In the end of this section the author has given an interesting forecast of Tariff Board's recommendations, the publication of which is expected shortly.

The main text is divided into two parts and contains a very detailed treatment of the various aspects of Indian Sugar Industry. The author has freely quoted from different authorities and has advanced his own views and arguments on the many questions relating to the industry and its problems.

Indian Sugar Industry has made rapid progress in the last five years during which period the country has been able to attain self-sufficiency in her sugar requirements. In fact, the white sugar production has just reached the country's needs for consumption and is raising problems of checking over production, and economic manufacture of sugar, to enable profitable exportation. This publication by Mr. M. P. Gandhi comes in very opportune, giving as it does a complete account of the industry's progress during these years.

The book is recommended for one and all interested in Sugar Industry

G. G. R.

The Design of Weirs on Permeable Foundations.*

THE design of weirs on permeable foundations has been thoroughly dealt with by Rai Bahadur A. N. Khosla, Dr. N. K. Bose, Dr. E. McKenzie Taylor and their colleagues in the present Publication No. 12 of the Central Board of Irrigation, India. Exhaustive investigations have been carried out by the authors, with the result that they are now able to present a fairly complete solution of the complex problem which is supported by data from prototypes in the field, models in the laboratory and by mathematical theory.

Until recently Bligh's Creep Theory was being adopted for designing weirs with component parts on sand or alluvial soil. This theory has been found to be defective from actual field observations and new formulæ have been evolved by the authors. The design of weirs on sand foundations which was hitherto based on assumption can now be worked out with exactness in a rational and scientific manner.

The publication consists of eleven chapters. Chapter I is mainly historical and traces the development of the science of subsoil hydraulics as related to weir design on permeable foundations from the earliest times to the present day. The earliest formula was given by H. D'Arcy for the flow of water through permeable solids in 1856 and the validity of the same was tested by Col. Clibborn in 1896. The investigations carried out by Col. Clibborn, Sir John Benton and others formed the first rational basis for the design of weirs on sand and they gave the idea of failure by undermining and uplift due to flow of water through the subsoil of the weir. Sir John Ottley and Thomas Higham developed from the results of experiments conducted by Col. Clibborn what is known as 'The hydraulic gradient theory' which came to be generally accepted in India. Bligh who originally believed that the stability of a weir depended on its weight, became subsequently converted to the hydraulic gradient theory and his enunciation of this theory is known as Bligh Creep Theory. This theory stated that the

* *Design of Weirs on Permeable Foundations.* By R. N. Khosla, N. K. Bose and E. McKenzie Taylor. Published by the Central Board of Irrigation, Simla, 1936. Pp. 178.

length of the path of flow had the same effectiveness length for length, in reducing uplift pressures whether it was along a horizontal or a vertical line. Following Buckley, he assumed the percolation water to creep along the contact of the base profile of the weir with the subsoil losing head *enroute*, proportional to the length of its travel. He called the loss of head per unit length the 'Percolation gradient'. The importance of vertical cut-offs at the upstream and downstream ends was lost sight of by him. The actual pressures indicated by pipes inserted in the floors of some of the weirs disclosed great disparity between those observed and calculated by this theory.

Chapter II deals with the theory of seepage flow, D'Arcy's law and its extensions as obtained by Schlichter. It is shown in this chapter how Schlichter's equation agrees with the well-known Laplace equation, which governs the steady flow of heat and electricity through a conductor and of a perfect fluid. It is established that the problem of flow of water through the subsoil is analogous to that of the flow of a viscous fluid or that of electricity through a conductor. This discovery of the analogy has led to the solution of the various problems connected with seepage flow.

The fundamental differential equation is given by Laplace as:

$$\frac{\delta^2 p}{\delta x^2} + \frac{\delta^2 p}{\delta y^2} + \frac{\delta^2 p}{\delta z^2} = 0.$$

It is thus shown that in the problem of subsoil flow the determination of equipressure surfaces is identical with that of the equipotential surfaces in the problems of the steady flow of electric currents through conductors.

Chapter IV describes the experimental verification of the potential law applicable to the flow of water through permeable homogeneous subsoils by means of models. Experiments with both hydraulic and electric models prove that the flow net of equipressure and stream lines for any particular weir profile is independent of (1) class and structure of subsoil so long as it is homogeneous; (2) scale or size of structure; (3) temperature so long as it is uniform throughout the medium; (4) applied head; and (5) upstream and downstream water levels. Conclusions 3, 4 and 5 have been arrived at from a study of the pressure observations at the Panjnad Weir.

Chapter V describes the erection of pressure pipes in Khanki Weir, Panjnad Weir, etc. The study of pressures in the Panjnad Weir is stated to have been the first experiment of its kind in the world and it has been instrumental in furnishing the final solution to the complex problem of weir design on sand foundations. In this chapter, the location of pressure points, precautions to be taken in the erection of pressure pipes, the observations to be made and the instruments used are explained in detail.

The method of recording observations made, standard forms to be used, and plotting of values obtained in the form of graphs are also described.

Chapter VI is devoted to the comparison of results obtained from models of Panjnad Weir, Khanki Weir, Lloyd Barrage, Deg Escape Head, etc., and their prototypes. A large amount of data is presented to prove that models can reproduce exact field conditions and the results obtained from models can be accepted as a safe guide for the designing of weirs. It is also shown how the actual observed uplift pressures do not exceed 82 per cent. of the designed pressure and there is thus a factor of safety provided by nature. The effect of silt and scour at the upstream and downstream of pervious floors and the difference in temperature of the river water and the subsoil are discussed. Silt upstream will reduce uplift pressures and that downstream will increase them. Similarly scour upstream will increase uplift pressures and scour downstream will reduce them. The latter may however lead to dangerous conditions eventually.

Chapter VII deals with the mathematics of weir design. The determination of uplift pressures and exit gradients for a number of cases of floors with pile lines in different positions below the floors is worked out mathematically. A number of tables and charts for different values and conditions are given in detail. A summary of Mr. J. K. Malhotra's mathematical investigations of the subsoil flow under two standard forms of structures consisting of a single depressed floor without aprons and a pair of equal sheet piles placed at the heel and toe of a flush floor is appended to this chapter.

Chapter VIII discusses the question of exit gradients as related to weir design.

The failure of a weir on sand from a seepage flow can occur by (1) undermining of the subsoil and (2) uplift due to pressure under the floor being in excess of the weight on the floor. The failure from the undermining of the subsoil which usually starts from the tail end of the work is the most common. Its causes and measures to prevent such failure are therefore discussed in detail. The investigations prove the absolute necessity of having some depth of piles or vertical cut-off at the tail end.

One general feature which is noticeable in all the experiments is that the insertion of a pile anywhere results in heading up or increase of pressure upstream and a reduction downstream, the increase or reduction being maximum at the pile and decreasing rapidly farther off. The main influence is confined to a radius equal to the depth of the pile. At twice the radius the influence becomes negligible.

The last chapter discusses principles governing the design of weirs in relation to the flow of water over the surface. The subject of surface flow is still lacking in researches and the design is based on empirical formulæ which may require to be modified in the light of investigations to be conducted in future. In subsurface flow, the chief factors which govern the design of weirs are (1) uplift pressures and (2) exit gradients. But in the case of surface flow the additional factor of dynamic impact has to be considered. The design in this respect will depend upon (1) the afflux, (2) the changes in the regime of river, (3) the discharge per foot run, (4) flood scour, and (5) the position and depth of the trough of the standing wave. The material discussed in this chapter represents the accumulated experience in the field supplemented by a limited amount of experimental investigations. The great need for further research in regard to surface flow is emphasised.

The book contains a large number of tables, graphs, diagrams and photographs of experiments which are highly interesting and useful in following the theoretical calculations. The authors and their colleagues deserve to be highly commended for their excellent work. V. G.

OBITUARY.

Pandit Hemraj.

PANDIT HEMRAJ, Principal, Dyal Singh College, Lahore, whose untimely death is being mourned in all circles, was born in Daffar, a village in the Hoshiarpur District of the Panjab, towards the end of the year 1886. His father Pandit Ganga Ram who survives him is a poor Brahmin. It was under hard circumstances, therefore, that Pandit Hemraj received his education. He passed his middle school examination from the S.D. School, in 1903, and his matriculation from the Government High School, Hoshiarpur, in 1905. He passed his B.A. and M.A. examinations from the D.A.V. College, Lahore, with distinction, standing first in the first class in the M.A. examination in 1912. Shortly after passing his M.A., Pandit Ji was appointed in October 1912, an Assistant Professor of Mathematics in the Dyal Singh College, Lahore. Pandit Ji's work thus came to the notice of the Panjab Government and Sir John Maynard, the then Vice-Chancellor of the Panjab University, moved the University to offer him a scholarship to go abroad for higher studies. The offer was not accepted for reasons of health. By hard work Pandit Ji rose to the Principalship of the College in 1921, and served it ably till the time of his death on the night of the 12th November 1938. His death has left a void in the academic life of the Panjab University.

HANSRAJ GUPTA.

CENTENARIES

By S. R. Ranganathan, M.A., L.T., F.L.A.
(*University Librarian, Madras*)

Nicoll, Whitlock (1786–1838)

WHITLOCK NICOLL, a British physician, was born at Treddington, Worcestershire, in 1786. His father who was rector of the parish died when Whitlock was but two years. He was educated by his uncle. He took his M.D. degree May 17, 1816 and became an extra-licentiate of the College of Physicians, London.

His Publications

He became a regular contributor to the *London medical repository* in 1819. His first book entitled *Tentamen nosologicums* classified diseases into (1) febres, (2) neuroses and (3) cachexiæ. In his *History of human economy* (1819) he developed a physiological approach to clinical medicine. *Primary elements of disordered circulation of the blood* (1819), *General elements of pathology* (1820), and *Practical remarks on the disordered states of the cerebral structures in infants* (1821) were his other books. Three of his papers on defective vision attracted some attention in his days.

His Honours

He became a member of the Royal Irish Academy in 1821 and was elected Fellow of the Royal Society in 1830.

After successful practice in London for about twelve years, he retired in 1835 and died December 3, 1838.

Overton, John (1764–1838)

JOHN OVERTON, a British writer on chronology, was born at Thetford, Lincolnshire in 1764. He got appointed in the excise.

Interest in Astronomy

He had a strong liking for astronomy. He constructed his own telescopes for his observations. His interest swerved to biblical chronology by about 1817 when he published the *Geneology of Christ with a new system of sacred chronology and the true meaning of the weeks in Daniel*. 2 V. In 1820 he brought out his *Books of Genesis and Daniel (in connection with modern astronomy), etc.* Two other books of his on related topics were *The chronology of the apocalypse investigated and defended* (1822) and *Strictures on Dr. Chalmers's discourse on astronomy* (1823).

Overton died at Chelsea December 1, 1838.

Hunt, Robert Woolston (1838–1923)

ROBERT WOOLSTON HUNT, an American metallurgist, was born at Fallingston, Bucks County, December 9, 1838. Having served in his father's drugstore for some time, he found employment for several years in an iron rolling mill.

First Analytical Laboratory

Having taken a course in analytical chemistry, he established in 1860 the first analytical laboratory as an integral part of an iron works at the plant of Canbrie Iron Co.

Bessemer Process

In 1865 this Company sent him to their plant at Wyandotte, Michigan where experiments were being made with the Bessemer Steel Process. In 1867 Hunt rolled for the Pennsylvania Railroad with Bessemer steel from the Pennsylvania Steel Company, the first commercial order for steel rails. From 1871 to 1888 he was in charge of Bessemer steel plants in several companies, until he established at Chicago the firm of Robert W. Hunt & Company. His *History of the Bessemer manufacture in America* published in the *Transactions* (1877) of the American Institute of Mining Engineers is an authoritative contribution.

Rails

He invented the very widely adopted rail mills. He was Secretary of the American Society of Civil Engineers which designed the rail section bearing the Society's name. In 1921 he proposed a new rail section and the nick-and-break test for soundness of each ingot.

His Honours

In 1912 he was awarded the John Fritz Medal and in 1923 the Washington Award. There have been established in his memory the Robert W. Hunt Medal and the Robert W. Hunt Prize awarded annually by the American Institute of Mining and Metallurgical Engineers.

Hunt died at Chicago July 11, 1923.

Burnham, Sherburne Wesley (1838–1921)

S. W. BURNHAM an American Astronomer was born at Thatford, Vermont, December 12, 1838. Having served in the army during the Civil War, he practised shorthand by himself and acted as official court reporter at Chicago for over twenty years. Though his days were fully occupied in taking down the court reports and writing them out in long hand, his tireless energy was such that he would carry out a full programme of astronomical observations at night. He worked at the Lick Observatory from 1888 to 1892 and was the first senior astronomer at the Yerkes Observatory from 1897 to 1914.

How He turned to Astronomy

When he was shorthand reporter at New Orleans, one afternoon as he was strolling along the street he heard a book auctioneer crying Burritt's *Geography of the heavens*. He bid for the book which was knocked down to him. On examining it he found it contained a chart of the sidereal heavens. In these he soon became interested and he bought a small telescope. By 1886 he got a better instrument and he also came in possession of Webb's *Celestial objects for common telescopes*. This determined his future line of work.

Double Stars

His chief fame rests on his work on double stars. It was then generally supposed that the Herschels had left no more double stars to be found. But Burnham's keen eye detected many stars with only a small fraction of a second of arc. His observations which were of the highest accuracy were made with great rapidity. He is said to have measured as many as one hundred double stars in one night. The total number of stars listed by him is 1,340.

His Publications

His results were published from time to time in several periodicals, the *Monthly notices* and the *Astronomische Nachrichtem* being the chief of them. But the most famous of his works is the *General catalogue of double stars within* 120° *of the north pole* 2 V. (1906).

History of the Catalogue

This *General catalogue* has a very interesting history, which is best told in the author's own words: "This catalogue in its first form was the result of my own needs soon after acquiring the six-inch Clerk refractor in 1870. From the beginning that instrument was devoted almost entirely to the observation of double stars. Objects were constantly found which could not be identified in any of the books....At that time there were but few books in Chicago bearing upon the subject of double stars....At that time to make a complete catalogue of the then known double stars, it was necessary to first make pen copies of nearly everything required for this purpose. These were secured by visiting libraries of the naval and other observatories and by borrowing books from various quarters. In this laborious way manuscript copies were acquired of the material parts of nearly all publications relating to double stars.... The manuscript general catalogue was kept continuously posted to date by the addition of all new stars and new measures from current publications. In order to make room for this new material a second manuscript edition became necessary and still later a third."

This went on till 1905 when the then newly established Carnegie Institute of Washington undertook to publish the *General catalogue* as the fifth of its publications. The book gives full data of about 13,665 double stars.

Burnham died at Chicago March 11, 1921.

INDUSTRIAL OUTLOOK.

A Method of Preparing Palmyra Jaggery for Refining.

By Victor M. Hinchy, M.Sc., F.I.C.

THE production of Jaggery in India is an age "old institution, a cottage industry" to be fostered and one which may rightly take its place in the internal economy of the country.

The sale of this commodity to factories for refining purposes is of increasing importance and it is in the interests of the producer and refiner alike that unnecessary loss should not occur during the interval between the purchase of the raw material and the manufacture of the finished white sugar.

Inversion of sucrose during this interval benefits neither producer nor manufacturer, yet the present system is to stock the raw material in godowns, more or less open to the elements, for a period of six to nine months to allow the mother liquor or runnings to drain from the crystals.

That such inversion does occur has been demonstrated, but the considerable loss involved has scarcely been appreciated.

In an attempt to determine the causes of deterioration, a series of experiments were initiated. These consisted in submitting samples of jaggery to pressure in desiccators containing (1) concentrated sulphuric acid, (2) 40% formaldehyde, (3) distilled water. Pressure was continued for a period of three months.

The result calculated on the basis of 100% solids are given below :—

	Original Jaggery	Jaggery pressed over H_2SO_4	Jaggery pressed over HCHO	Jaggery pressed over H_2O
Pol.	86·02	89·74	64·90	17·32
Invert sugar	2·74	1·77	1·25	16·03
Soluble ash	3·90	2·06	1·38	2·44
Insoluble matter	3·74	4·93	19·84	31·43
Other non-sugars	3·60	1·50	12·63	32·78
R.V.	63·78	77·67	56·75	− 10·91
Weight of original jaggery ..	354·80	354·8	354·8	354·8
Weight of final jaggery	..	334·1	97·6	31·4
Percentage of Solids removed ..	..	5·8	72·5	91·1

It is obvious from these results that if jaggery is pressed under perfectly dry conditions, it not only does not deteriorate during a period of several months, but by the elimination of the impurities in the mother liquor, the refining value of the raw material is increased considerably.

Since however it would be difficult to maintain these conditions on a commercial scale, the effects of pressure for a short period only were investigated.

A screw press of the type used in bagasse analysis, was employed and the jaggery was analysed after six hours continuous pressure. The results obtained may be summarised as follows :

(1) Over 11% of the original weight of jaggery was expressed as 'runnings'. This is a fair average figure for the quantity usually removed during storage for six months or more.

(2) 7·1% only of the original sucrose present in the jaggery was removed in the runnings.

(3) 54% of the invert. sugar passed out of the jaggery.

(4) 33·5% of the soluble ash was found in the runnings.

(5) The refining value of the jaggery calculated to 100% dry matter increased from 66·10% to 73·94%.

Finally, a jaggery pressed during a period of a few hours would be superior to that

ordinarily melted and thus would be considered an excellent raw material for the refinery.

The type of large-scale equipment required for this purpose is a hydraulic press with interleaves of metal between the cakes of jaggery. One press at each centre for the purchase of jaggery would deal with the material as it arrives, the treated jaggery being sent on to the refinery for immediate melting and the runnings being resold direct to the ryots.

ASTRONOMICAL NOTES.

Planets during January 1939.—Mercury is a morning star and will be at greatest elongation (22° 49′ W.) from the Sun on January 3. Venus will continue to be a bright object conspicuously visible in the eastern sky for nearly three hours before sunrise; the stellar magnitude will be about −4·2. On January 30, the planet reaches greatest elongation from the sun (46° 56′ W.). Mars is moving slowly eastwards in the constellation Libra and can be observed in the latter part of the night. On January 15, there will be a close conjunction of the planet, with the Moon the distance between them being only about one-third of a degree.

At sunset, Jupiter will be low down in the western sky, while Saturn will be visible as a first magnitude star slightly west of the meridian. The ring ellipse is beginning to widen, the angular dimensions of the major and minor axes being 39″·4 and 5″·9 respectively. Uranus will be on the meridian at about 7 p.m. and can be easily located, being only about a degree north of the fifth magnitude star σ Arietis; on January 22 it will be at one of the stationary points of the geocentric orbit. The moon will closely approach the planet on January 1, and again on January 29.

Jupiter's Satellites X and XI.—From observations secured at Mt. Wilson, Dr. Paul Herget has derived an orbit for J. XI (*U.A.I. Circ.* 730) which indicates that the satellite is moving round the primary in a retrograde direction. The eccentricity is 0·21 and the period 692·5 days. The elements of the orbit computed for J. X. agree very closely with those of the sixth and the seventh satellites of Jupiter. These newly discovered objects are extremely small bodies having probably diameters not exceeding 5 miles.

The Variable Star R Coronæ Borealis.—This is a peculiar variable star which is normally of constant brightness (6th magnitude) but occasionally becomes faint, abruptly dropping several magnitudes in brightness. After an interval which is never uniform, the star gets brighter and resumes its original brightness. On 1938 October 30, the star was observed to have declined to magnitude 9·4 and on November 2 to magnitude 10·5 (*U.A.I. Circular* 731). The last minimum occurred in December 1934 when the star's magnitude dropped to 10·4.

T. P. B.

ANNOUNCEMENT of the brightest stellar object ever discovered has been made by Dr. Fritz Zwicky, astrophysicist of the California Institute of Technology in association with Dr. Walter Baade of the Mount Wilson Observatory staff. This brilliant supernova, tentatively called *I.C. 4182*, was located by means of the 18-inch Schmidt Telescope at the Palomar Observatory. It is apparently of a luminosity about 400,000,000 times that of the sun.—*Sky*, 1938, **3**, 30.

RESEARCH ITEMS.

A Light Filter for the Isolation of the Mercury Green Line.—The green line of the mercury arc is the most intense in the mercury spectrum and it permits of excellent Raman spectra to be taken of photochemically sensitive substances, those which fluoresce when exposed in the blue region or coloured substances which show absorption in the region. Aqueous cupric chloride solution to which concentrated hydrochloric acid or chlorides have been added shows absorption in the blue and red region and transmits 5000–6000 Å. Addition of neodymium chloride to the above solution greatly narrows the range on both sides and transmits sharply about 5460 Å. For Raman measurements according to Stoll (*Ber.*, 1938, **71**, 1576) one uses a 5 mm. thick layer of a semi-saturated solution of neodymium chloride to which 20 per cent. wt. (on water used) of cupric chloride has been added. This solution transmits 80 per cent. green and less than 0·1 per cent. of yellow and blue, and nothing of red, violet and ultra-violet. A saturated solution of neodynium chloride transmits the green line 100 per cent. Hence one can also saturate the above solution with neodymium nitrate or didymium nitrate before use. It is a clear, transparent and stable solution.

B. S. R.

Polycyclic Aromatic Hydrocarbons.—The polycyclic aromatic hydrocarbons are of importance as parent substances of steroids, œstrogenic and carcinogenic substances. Their synthesis and properties have engaged the attention of Ch. Weizmann and E. Bergmann (*Scripta Academica Hierosolymitana* Scientific Report, 1938, **1**, 1–28). In the synthesis of anthraquinone derivatives by condensing phthalic anhydride with aromatic hydrocarbons, Weizmann introduced useful modifications by suggesting the use of boric acid instead of aluminium chloride and interaction with Grignard compounds, good results being obtained with dihydroxy-naphthacene-and-pentacene quinones. A method based on allyl-benzenes isomerising to hydrindenes and butyl-benzenes into tetrahydronaphthalenes has been employed by the authors for obtaining a lower homologue of rubrene. The authors suggest a more probable formula for *iso*rubrene of Mureau and Dufraisse. The possibilities of the diene methods and those of I. G. Farbenindustrie based on removal of HCl from chlorostillbenes have been extensively studied by the authors. X-Ray investigations have shown rubrene molecule to be not flat like many known hydrocarbons. Another topic of interest dealt with by the authors is the formation of naphthafluorene type of aromatic hydrocarbons from steroids by dehydrogenation.

B. S. R.

About the Betulenols.—According to Triebs (*Ber.*, 1938, **71**, 612, 1794) it seemed possible that in the plants betulenole was formed by the biological oxidation of the methylene or methyl side chains of the natural caryophyllene mixture which appears to consist of α, β and γ-caryophyllenes. Betulenolic acid obtained from the sesquiterpene alcohol betulenole has been shown to be identical with homocaryophyllenic acid from caryophyllene. The alcohol and acid obtained by oxidation of the caryophyllene mixture with potassium permanganate has been shown to be identical with betulenole and betulenolic acid.

B. S. R.

About the Bacterial Hydrogenation of Androstendione and Testosterone.—Luigi Mamoli and Gerhard Schramm (*Ber.*, 1938, **71**, 2083) have shown that pure Androstendione and Testosterone treated with the clear aqueous extract obtained from finely comminuted bull-testicle after 2 days contact gave excellent yields of atiocholandione and epiatiocholandiol. The same substances treated with a sterile extract treated with chloroform or toluol were recovered uneffected quantitatively.

B. S. R.

Bleaching of Cane Syrups by Sulphur Dioxide.—In a paper presented at the Seventh Annual Convention of the Sugar Technologists' Association of India, Parashar has discussed the bleaching action of sulphur dioxide and the limits of pH suitable for sulphitation of cane syrups. The change in the pH of syrup and its decolorisation are very rapid in the initial stages of sulphitaton and as the pH is lowered, comparatively larger amounts of sulphur dioxide are needed for effecting the same bleaching and pH lowering. The maximum range of sulphitation recommended for cane syrups in the light of this, is 5·2–5·4, the lower pH being suitable for low purity syrups.

During the boiling of sulphited syrup in the vacuum pan sulphur dioxide always escapes but the beneficial effect on the white colour of the sugar is still derived. This is due to the fact that a sulphited syrup reduces the colour absorption by the sugar at the graining point. It is pointed out that the resulting colour of the sugar is largely determined by the colours absorbed at the point of graining ; during the growth of crystal, colour absorption takes place only to a very small degree. It is therefore recommended that the syrup employed for granulation must be maintained at a high degree of sulphitation (pH 5·2–5·4) and in the later stages of boiling, less acidic syrup can be employed.

The use of a bleaching agent like blankit during boiling must therefore be made judiciously, so as to obtain the maximum beneficial effect. When employed at the time of graining blankit helps to keep down the colours that are generally absorbed by sugar crystals but its employment at later stages of boiling especially at the strike time does not appear to serve any useful purpose.

For the reasons mentioned above regarding the absorption of colours by sugar at the granulation stage, the practice of mixing molasses with sulphited syrups for graining is to be disapproved.

The Twelfth International Horticultural Congress, Berlin, 1938.

SCIENCE AND SPORT have no frontiers, and it is natural that international meetings in connection with either of these departments of human activity should be the order of the day. Berlin was the stage of the Twelfth International Horticultural Congress in August this year (1938).

The Indian delegation to the Horticultural Congress consisted of Dr. W. Burns (Agricultural Expert, Imperial Council of Agricultural Research), Dr. H. Chaudhuri of the Punjab University, and Mr. K. C. Naik, B.Ag., M.Sc., Superintendent of the Fruit Experimental Station at Kodur (Madras). As the Congress was divided into no less than 20 sections, the three delegates arranged as far as possible to attend different sections, in order to give and get as much information as possible. All, however, attended the session of the Tropical Section of the Congress, of which Dr. Chaudhuri (at the invitation of the German organisers of the Congress) had the honour to be the first president and to deliver the presidential address. During the discussion Dr. Burns gave an account of the organisation of horticultural research in India.

All meetings were held in the Kroll Opera House, which has, in addition to its main great auditorium, many rooms of all kinds which were used for the sectional meetings, and for some of the social events. The opening meeting of the Congress was held in the great auditorium which was decorated for the occasion with that colour and lavishness that one expects from a régime that has perfected the art of mass displays. Behind the rostrum was a vast map of the world ; against it were ranked the banners of over fifty nations, and in the centre was suspended an enormous golden rose, the symbol of the Congress, also worn on the badges of all delegates.

Arrangements had been made for all meetings held in this hall and also in some of the smaller rooms whereby delegates could hear any speech in any one of four languages : German, Italian, French or English. This was done by a system of interpreters each speaking into a telephone while the listener had at his seat another telephone and a switch that enabled him to listen to any one of these interpreters.

The Congress was officially opened by the Reich Minister for Food and Agriculture (Herr R. Walther Darré) who welcomed the delegates and pointed out how the International Horticultural Congress had grown from small beginnings to be the forum of horticultural specialists from all parts of the world. He emphasised the fact that there is scarcely any field of activity so varied as horticulture, proceeded to point out the increasing importance of fruit and vegetables in world trade and human diet and remarked on the number of new problems that all this had raised. He also stressed the cultural significance of horticulture (for the Congress had several sections dealing with the cultural and æsthetic side of the subject).

Some of the papers on this aspect of horticulture were distinctly stimulating, particularly perhaps the paper on " Park and Garden Planning " by Dr. Jensen of the United States who was against all clipped hedges, in fact, anything artificial and wanted a park or garden to be a living example of the cultural life of the people. He mentioned as an instance of the Lincoln Memorial Garden (planned by himself) designed to express beauty and strength, the beauty of the land and the strength of character of Lincoln.

Dr. Wirz (Germany) gave an interesting lecture on " The Significance of Fruit and Vegetables for National Health and Vitality " followed by a practical demonstration in the shape of a breakfast of fruit and vegetable dishes prepared in a wonderful variety of ways. Dr. Trouvelot (France) dealt with outstanding success in biological control of pests of horticultural crops. These lectures belonged to the general part of the programme as did the excellent lecture by Col. Durham (Secretary of the Royal Horticultural Society of England) on " The Object and Purpose of Exhibitions and Trials of New Varieties in regard to the Advancement of Horticultural Breeding ".

Among the sectional papers, a notable one was that of Mr. Charley of Long Ashton (England) dealing with fruit beverages of the unfermented group, a subject of much interest to India, and one in which considerable headway has been made at the Agricultural College in the Punjab (work jointly financed by the Punjab Government and the Imperial Council of Agricultural Research).

A section of considerable potential interest to India was that on " Storage of Fruit and Vegetables ". The main speaker did not deal much with tropical fruits, but this lack was made good by the communication of Dr. Wardlaw of Trinidad, already well known to tropical workers from his series of papers on cold storage, in the *Journal of Tropical Agriculture*. He stressed the need for finding the best stage of maturity and the best temperature for each kind of fruit and pointed out that the long transport that had to be endured by tropical fruit meant a higher storage temperature and an earlier stage of maturity at picking. He emphasised the need to get tropical fruit into store as quickly as possible to avoid wound parasites and to prevent the onset of ripening due to the warm environment, and pointed out that well-equipped shipping was a fundamental requirement.

It is impossible to deal even slightly with the many admirable communications, but mention must be made of the paper by Dr. Hatton (East Malling, England) on " The Present Status of Research on Rootstock Plants and the Use of Rootstock Plants," in which he traversed a field where his own experiment station has given a brilliant lead. During the discussion on this paper, Mr. Naik dealt with rootstock problems in mangoes and citrus species and mentioned the fruit research schemes subsidised by the Imperial Council of Agricultural Research.

During the Congress one member of the Indian delegation visited the world-famous Plant Breeding Institute founded by the late Prof. Edwin Baur at Müncheberg, and another visited the Horticultural Experiment and Research Institute at Dahlem.

The social entertainments by the Reich Government and by the Central Association of

German Horticulturists were enjoyable affairs and also led to a great number of useful personal contacts. These personal contacts are one of the most valuable results of such international congresses. The man one meets is no longer a mere name but a person with whom one can have a correspondence with friendship and understanding behind it.

From this Congress has been gained a series of summaries of the present state of knowledge in horticulture and also useful details in many branches of horticultural practice. India's horticultural problems and achievements were presented and many friends made. Lastly, India had the chairmanship of an important section.

W. B.

SCIENCE NOTES.

The Mohenjodaro Civilization.—The work executed during the four seasons 1927–31, detailed accounts of which are given in a recent publication entitled "Further Excavations at Mohenjodaro" by Dr. Ernest J. H. Mackay, has thrown more light on the life of the ancients who peopled the Indus Valley 5,000 years ago. The presence of the Indus Valley seals in Sumarian cities, points to the trade connections between the two countries. The city's sanitation appears to have been very carefully looked after. A mound, proved to be a heap of rubbish, has been discovered, at some distance from the area occupied by the houses, showing that the idea of removing rubbish was being acted upon. Relics of the playful pastimes of children has been unearthed; carts of pottery pulled by toy bullocks are among the interesting finds made as a result of the excavations.

* * *

Assam's Coal Resources.—Recent investigations by the Geological Survey of India, mainly concerned with the unravelling of the structure of the rocks and incidentally with the continuity of the coal seams, have revealed the existence of workable coal in the south-eastern part of the Garo Hills and South-western area of the Khasi Hills, in Assam.

There appear to be two main seams of coal—an upper, varying from 18 inches to 4 feet, and a lower, varying from 3 feet to over 6 feet. The upper is relatively inferior while the lower seam is of good quality coal.

Presuming the coal seams to be continuously present under the areas indicated, it is computed that the reserves of coal, in the low seam only, average about 75,000,000 each in the Langrin and Nongstoin areas within a depth of 500 feet of the surface, and probably over 500,000,000 tons in the area south of the Tura range west of Chutmang mountain, at depths from 200 to 1,000 feet.

The Daranggiri coalfield reserves are estimated at 75,000,000 tons with coal lying at depths of 300 to 400 feet. In all these cases expensive boring must be carried out to prove the lower seam, and coal will ultimately have to be worked from shafts varying from 200 to perhaps 800 feet deep, and in most cases a railway or ropeway communication should constitute an important consideration.

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India's Educational Problems.—The Wardha Education Scheme was the main subject of deliberation before the Central Advisory Board of Education, which met in New Delhi on December 3, 1938.

In January, 1938, the Board appointed a Sub-Committee under the chairmanship of the Hon'ble Mr. B. G. Kher, Premier and Education Minister, Government of Bombay, to examine the scheme of educational reconstruction incorporated in the Wardha Scheme in the light of the Wood-Abbott Report on General and Vocational Education and other relevant documents. This Sub-Committee met in Simla in June last and submitted its report to the Board on December 3, 1938. The Board generally approved the recommendations.

The Sub-Committee first attempted to clear the misunderstandings and misconceptions which had gathered round the Wardha Scheme and then considered its various aspects. In its opinion, these misunderstandings had arisen from either a misconception of the fundamental ideas on which the scheme rests or from the statements made by its enthusiastic but misguided protagonists or from some of the phraseology of the Zakir Husain Report itself which is the authoritative Wardha Scheme of Education. The Sub-Committee observed that the Wardha Scheme as presented in the Zakir Husain Report was one of education through activity and not of production as is generally believed, and that this scheme was in full agreement with the recommendations made in the Wood-Abbott Report so far as the principle of learning by doing was concerned.

The Sub-Committee discussed whether or not it was possible to teach through the basic craft all subjects to the standard anticipated. There was general agreement that in the lowest classes education could be satisfactorily carried out through activities, but certain elements of cultural subjects which could not be correlated with the basic craft must be taught independently. Again, spinning and weaving should not be the only basic craft but any craft of equal or higher educative possibilities could be taught. Stress was laid on the report of the Sub-Committee on the training of teachers, the raising of their status and pay, etc. While generally approving these recommendations, the Board decided that copies of the Sub-Committee's report should be forwarded to Provincial Governments for consideration.

The Sub-Committee did not consider the question of financing the Wardha Scheme as this was outside its terms of reference, nor did it make any recommendation as regards the coordination of this scheme with higher education. To examine these questions of finance and coordination and certain other matters arising out of the Wardha Scheme, the Board appointed another Sub-Committee of which the Hon'ble

Mr. B. G. Kher, Premier and Education Minister, Government of Bombay, is to be the Chairman.

Another subject of considerable importance that engaged the attention of the Board was the problem of adult education and illiteracy. It was explained that some provinces were now beginning to make serious attempts towards the removal of adult illiteracy. The Board felt that this was one of the most important problems to be examined on an all-India basis. It accordingly appointed a Sub-Committee with Dr. Syed Mahmud as Chairman to examine this problem carefully and to report to the Board in due course.

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The Malaria Survey of India, 1927–1937.—The history of Malaria research in India during the early years of the present century and the scope and activities of what is to-day known as " The Malaria Institute of India ", has been described in a recent pamphlet issued by the Director of the Institute. While acknowledging the valuable contributions by such pioneers as Christophers, Bently, Fry, Graham, Hodgson and Sinton to the epidemiology of malaria in India, special mention is made of the work by Sinton and his collaborators on quinine and Totaquina in the treatment of malaria and the work of Taliaferro and Mulligan on the Histopathology of malaria. A chronological review of the Malaria Surveys conducted by the members of the Staff is given with a useful classified list of publications at the end.

Important amongst the several activities of the Institute is the annual malaria class, for giving both theoretical and practical training in Malariology to members of the medical and public health professions.

B. A. R.

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The Annual Report of the London Shellac Research Bureau for the financial year 1937–38, which has been issued by Mr. A. J. Gibson, Special Officer, Lac Inquiry, constitutes an interesting and valuable document.

The total lac exports from India to foreign countries suffered a serious fall by about 21 per cent. Although we are assured that this fall is not discouraging as it has been shared by many other commodities from India and elsewhere, we feel that it would be advisable to investigate the cause of this substantial and serious reduction in the export of lac which is peculiarly susceptible to the danger of either total or partial replacement by synthetics. The ruling market rates of lac, at the moment, are below the cost of production and immediate steps should be taken to stimulate the market.

Mr. Gibson has continued his work as Special Officer, Lac Enquiry, with characteristic enthusiasm and energy. He has popularised the employment of lac in Industry by lectures, by establishing personal contacts with specialists and manufacturers, by contributing articles and reviews to the technical press and participating in most of the International Exhibitions in Europe.

Regarding competition from the synthetic resin industry, it is pointed out that "as research work in lac expands it becomes more and more apparent that for certain uses synthetic resins hold the field and will continue to hold the field ". Synthetic resins for example, will dominate the field of mouldings of the closed mould type ; lac cannot hope to compete with resins of high melting point and those which exhibit outstanding weather-resisting properties. Encouraging results have, however, been obtained with injection mouldings using various lac moulding powders. This line of work should be more intensively and more systematically pursued. Attention should be drawn to the successful preparation of a " Hard lac resin "-urea-micronised-mica-filler injection moulding powder by Messrs. The Metropolitan-Vickers Electrical Co., Ltd., to the manufacture of jute boards bonded with shellac, and to the process of hot-spraying of powdered lac.

* * *

Jute Substitutes.—According to the information contained in the *Bulletins* of the Indian Central Jute Committee, a new company called Compania De La Juta E Di Fibre Similare D'Etiopia has been floated with a starting capital of 10,000 Lire. The intention of the prime movers of this project, is to cultivate fibres which can serve as substitutes for jute in East Africa.

The Department of Agriculture, South Africa has been experimenting with Brown Hemp, or *Hibiscus canabinus*, indigenous to South Africa, for some years and have arrived at the conclusion that this annual, which often reaches a height of 7 feet, can be cultivated on a wide scale and used as a substitute for jute. *Hibiscus bifurcatus*, a native plant of Brazil, has been found to be useful as a substitute for jute in that country.

A new type of heavy paper suitable for the manufacture of sacks has been made by Dr. Tunji Torii, Chief Chemist of the Japanese Bag Company, Tokyo. The product is reported to be better than hemp or leather, in resisting water and sand, and it is claimed that its strength increases when left in water for prolonged periods. In Munchukuo, *Kenaf* is being cultivated on a large scale with a view to eventually substitute it for jute.

In Belgian Congo, *Urena Lobata* and Punga fibres, which were introduced in 1930, have achieved a position of relative importance as substitutes for jute.

Rosella is being cultivated in Java, and *Rosella* bags are being extensively employed in the sugar trade in the place of jute bags. It is expected that unless unforeseen circumstances arise, Java will become self-supporting in 3–4 years, at least so far as sugar bags are concerned.

* * *

Cell Adoption to Poisons.—A report on the presence, in living animals, of a mechanism through which the cells are enabled to resist poisoning by changing their structure, was presented by Prof. William D. MacNider, Dean of the Faculty of Medicine, North Carolina, at the Autumn meeting of the National Academy of Sciences, U.S.A. (*New York Times*, October 26). The resistance against poisons developed in the livers and kidneys of animals, is not specific to

any one substance. It is produced as a result of the change in the structure of the tissues. When uranium nitrate is administered in doses large enough to injure the cells of the kidney and liver, the cells elaborate a defensive mechanism by building at an entirely new type of cell, flattened in shape and smaller in size, and possessing a resistance not only against uranium nitrate but also against mercuric chloride, chloroform and alcohol. These new cells resemble certain types of embryonic cells, known to resist these poisons. Similar cells have been observed in senescent animals indicating that a similar process takes place naturally in the aging animal as part of a natural defence against the ravages of life.

(By the kind courtesy of the Editor, *World in Brief*, New York.)

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Beneficial Insects of Mysore check Fruit Fly Menace in Australia.—Dr. Gurney, Entomologist, New South Wales, Australia, visited Mysore State during July, August and November-December of 1935 and made a special study in the Entomological Laboratory of the Agricultural Department of cetain Hymenopterous parasites of the fruit flies of a variety of cultivated fruits as well as a number of those occurring wild; some three species of the common indigenous fruit fly, Chætodacus infesting specially guavas, solanum and sandal berries, were found to be subject to the attacks of two varieties of Hymenopterous parasites I. Opius (Braconidæ) and Syntomosphyrum (Chalcidæ) and a fair percentage of the fruit fly maggots were noticed to be naturally controlled. Dr. Gurney had most active collaboration from the Entomological Section of the Department of Agriculture, Mysore State, and sent several consignments of the parasites to Australia. After he left India, many more batches of parasites were forwarded to him. The parasites, specially the chalcid *Syntomosphyrum indicum*, established itself and spread rapidly in Australia and have already been responsible to a very appreciable control of the serious fruit fly *Chætodacus tryoni*, that had threatened to become a great menace to the fruit industry in the Island.

* * *

"**Jutex**".—According to a recent *Bulletin* of the Indian Central Jute Committee, a new material, "Jutex", made from jute and artificial resin, is being manufactured by an Austrian firm. The material is light (sp. gr. 1·4), durable and firm, and finds a variety of uses in industries such as, manufacture of cog wheels, motor and motor car accessories, etc. It is described as a perfect substitute for metal and some Austrian factories are reported to have been using machine accessories made of this material.

* * *

The Seventh Annual Convention of the Sugar Technologists' Association of India was held at Cawnpore on 16th and 17th October 1938 under the chairmanship of Rao Saheb V. P. Iyer and was largely attended by members and visitors.

The President of the Association, Sirdar Kripal Singh Majithia, was unavoidably absent and his address was read by the Chairman. Among the important points dealt with in the address were the activities of the organisation—the Indian Sugar Syndicate, Ltd., the problems of the industry and suggestions for the formation of a Committee to introduce uniform methods of chemical control in factories.

While the number of papers presented at the Convention was less than the previous year, they were of a high technical standard and evidence a good deal of interesting and lively discussions.

A Business Meeting of the Association was held on 17th October when the Hon. Secretary, Mr. R. C. Srivastava, announced that 57 factories had joined the Association. He also said that the Association jointly with the Indian Sugar Mills Association, had approached the Government of India to invite the International Society of Sugarcane Technologists to hold their Seventh Session in India. Reviewing the position of sugar industry in India he pointed out that there was a decrease in production of sugar by 16·3 per cent. during the 1937–38 season due to less area under cane. A further shortage was expected in the coming season 1938–39.

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The National Academy of Sciences, India.—At the meeting held on the 29th November, at the headquarters of the Academy, the Council decided to award the Education Minister's Gold Medal, to Prof. Birbal Sahni, SC.D., F.R.S., in consideration of his paper entitled "Materials for a Monograph of the Indian Petrified Palms", published in the *Proceedings* of the Academy. The Council elected Dr. Ram Behari, M.A., PH.D., Reader in Mathematics, University of Delhi, and Mr. Saradindu Basu, M.SC., Meteorologist, Upper Air Observatory, Agra, as Fellows of the Academy.

* * *

Indian Chemical Society.—At the ordinary meeting of the Society held on Friday, November 25, at the University College of Science, Calcutta, the following Office-bearers were elected by ballot, for the coming year.

President: Dr. H. K. Sen; *Vice-President*: Dr. P. Neogi; *Hon. Secretary* Dr. P. K. Bose; *Hon. Treasurer*: Dr. A. C. Sircar; *Hon. Editors*: Prof. P. C. Ray and Dr. J. N. Ray; *Hon. Auditors*: Dr. P. C. Nandi and Mr. T. K. Roychaudhury.

The following chemists were admitted as Fellows of the Society.—Mr. N. P. Datta, M.SC. (*Calcutta*) and Mr. P. N. Bagchi, M.SC. (*Calcutta*).

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Andhra University.—Mr. K. M. Pandalai, M.SC., has been awarded the PH.D. degree of the Andhra University in consideration of his thesis entitled "Biochemistry of Nitrification".

Mr. N. M. Philip has been awarded the degree of Master of Science (M.Sc. Hons.) in consideration of his thesis entitled "Compressibilities of Liquids in relation to Light Scattering and other Physical Properties."

Royal Institute of Science, Bombay.—(1) Prof. G. R. Paranjape has assumed charge as Principal of the Institute *vice* Dr. T. S. Wheeler on leave. (2) Dr. R. C. Shah has been appointed

to do duty as Professor of Organic Chemistry in place of Dr. T. S. Wheeler. (3) Dr. (Miss) Banoo Khanbatta has been appointed as an additional Assistant Lecturer in Chemistry. (4) Dr. Karandikar has taken the place of Mr. Bal (on leave in England) as Assistant Lecturer in the Zoology Department.

University of Calcutta.—The degree of Doctor of Sciences (D.Sc.) has been conferred on Mr. K. V. Giri, M.Sc., A.I.I.Sc., Nutrition Research Laboratory, Coonoor, in consideration of his thesis bearing annominats on enzymes.

University of Mysore.—*I. Examinations.*—The results of the LM.P. Examinations held in October 1938 were published. They were as follows :—

	No. examined	No. passed
First L.M.P. ..	17	9
Second ,, ..	25	17
Third ,, ..	45	22
Final ,, ..	46	26

II. Extension Lectures.—The following lectures were delivered under the scheme of Extension Lectures during the month :—

(1) Dr. M. H. Krishna, M.A., D.Lit., Professor of History, Maharaja's College, Mysore, on "Archæology in Mysore", at Chikmagalur and Hassan : (2) Sriman Sangeetha Shastra Ratna Sangeetha Vidwan K. Vasudevacharya, Mysore, on "Music" at Mysore and Bangalore ; (3) Dr. Gualtherus H. Mees, M.A. (Cantab.), LL.D. (Leyden), Fellow, Netherlands Sociological Society, "The Deeper Aspects of Education," at Mysore ; "The Old Religions and the New Psychology," at Bangalore ; (4) Mr. S. V. Viswanatha, M.A., L.T., retired Professor, Coimbatore, a course of three lectures : (i) "Pre-Historic Mysore," (ii) "Early Royal Dynasties," (iii) "Cultural Contribution of Early Mysore," at Mysore.

III. Meeting of the Senate.—The ordinary meeting of the Senate for the year was held on the 26th November 1938. Among the propositions that were passed, mention may be made of the following :—

(1) Institution of the following additional group of optional subjects in the Intermediate Science and the B.Sc. Pass degree course : Economics, Geology, Chemistry ; (2) Reduction of the minimum for compartmental pass in the Intermediate examination from 45 to 40 per cent.; (3) Institution of the Honours course in Politics ; (4) Revision of the Scheme in respect of the Second and the Final Examination for the M.B.B.S. degree ; (5) Organization of a University Settlement ; (6) Investigation of the question of abolishing the Medical School at Bangalore ; (7) Making Physical Exercise compulsory in the University from the year 1939–40.

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Dr. J. S Patel, Oil Seed Specialist to the Government of Madras, has been appointed Jute Specialist under the Indian Central Jute Committee.

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Sir William Bragg has been elected President and **Prof. A. V. Hill** and **Prof. A. C. G. Egerton,** Secretaries of the Royal Society.

Announcements.

Lucknow University.—*Programme of Science Lectures for the Winter Session,* 1938–39.—

January 10, 11 and 12.—Prof. K. S. Krishnan, M.A., D.Sc. : "Magnetic Properties of Crystals." January 13, 14 and 15.—Professor W. Burridge, D.M., M.A. : "Medical History, with special reference to the Indigenous Systems of India". January 16, 17 and 18.—Prof. N. Sen Gupta, M.A., Ph.D., P.R.S. : "Heredity in Mental Traits". January 20, 21 and 22.—Dr. A. N. Singh, D.Sc. : "The Fundamental Theorems of the Differential Calculus." January 28 and 29.—Prof. B. R. Seth, D.Sc. : "Two Dimensional Potential Problems." February 11, 12 and 13.—Dr. Hansraj Gupta, M.A., Ph.D. : "The Theory of Integral Numbers". February 16, 17 and 18.—Prof. A. B. Misra, "Reproduction in Indian Birds".

Indian Chemical Society.—The next Annual General Body Meeting of the Society will be held at Lahore at 2–30 P.M., on 4th January 1939, in the Chemistry Section meeting room of the Indian Science Congress.

The fourth Annual Meeting of the **Inter-University Board** will be held in Bombay on 27–28 February, 1939.

National Institute of Sciences.—The Fourth Annual General Meeting of the Institute will be held on January 2, 1939, in the Hailey Hall, Lahore.

Indian Statistical Conference.—The second session of the Indian Statistical Conference will be held in Lahore in the first week of January, 1939. His Excellency the Governor of the Punjab has kindly agreed to open the Conference on Thursday, the 5th January 1939. A Reception Committee has been formed in Lahore with the Hon'ble Mr. Manohar Lal, Finance Minister of the Punjab Government, as the Chairman.

The work of the Conference will be carried on in active co-operation with the Indian Science Congress which will also meet in Lahore at the same time. A joint meeting will be held with the Section of Mathematics and Physics of the Science Congress in which a special discussion will be held on "the techinque of random sample surveys", and papers in theoretical statistics will be taken up for consideration. A joint discussion will be held in the Section of Anthropology on "the application of statistical methods in anthropometry" ; and also a joint meeting with the Section of Agriculture. Attempts are being made to arrange a joint discussion with the Section of Medicine and Public Health. There will be a special section of the Conference devoted to *Economic and Business Statistics.*

The first **All-India Conference of Mental Specialists** will be held in Lahore on 23-24 January, 1939. The Conference has been organised by the newly formed Indian Division of the Royal Medico-Psychological Association.

Our attention has been drawn by Messrs. Thomas Murby and Co., London, to an error review notice on *Agricultural Analysis* by C. H. Wright, appearing in this Journal

(October, 1938, p. 190). It is mentioned that the author has omitted to refer to the polariscopic method for the estimation of sugar. We have now been informed that this is not correct. The method for determining lactose in milk (p. 235 of the book) and sucrose in sweetened condensed milk (p. 261) are both polariscopic methods. We regret the error.

We acknowledge with thanks receipt of the following :—

" Nagpur Agricultural College Magazine," Vol. 13, No. 2.

" Agricultural Gazette of New South Wales," Vol. 49, No. 11.

" Journal of Agricultural Research," Vol. 57, No. 7.

" Monthly Bulletin of Agricultural Science and Practice," Vol. 29, No. 10.

" The Philippine Agriculturist," Vol. 27, No. 6.

" Journal of the Royal Society of Arts," Vol. 86, Nos. 4484–87.

' Biochemical Journal," Vol. 32, No. 10.

' Biological Abstracts," Vol. 12, No. 7.

" Journal of the Institute of Brewing," Vol. 44, No. 11.

" Chemical Age," Vol. 39, Nos. 1009–12.

" Journal of Chemical Physics," Vol. 6, No. 11.

" Journal of the Indian Chemical Society," Vol. 15, No. 9.

" Berichte der Deutschen Chemischen Gesellschaft," Vol. 71, Nos. 11 and 12.

" Experiment Station Record," Vol. 79, No. 5.

" Transactions of the Faraday Society," Vol. 34, No. 211.

" Forschungen und Fortschritte," Vol. 14, Nos. 31–33.

" Genetics," Vol. 23, No. 6.

" Journal of the Geological, Mining and Metallurgical Society of India," Vol. 9, Nos. 1–2.

" Review of Applied Mycology," Vol. 17, No. 11.

" American Museum of Natural History," Vol. 42, No. 4.

" Nature," Vol. 142, Nos. 3600–03.

" Journal of Nutrition," Vol. 16, No. 5.

" Canadian Journal of Research," Vol. 16, No. 10.

" Journal of Research " (National Bureau of Standards), Vol. 20, No. 6.

" Sky," Vol. 3, No. 1.

" Indian Trade Journal," Vol. 131, Nos. 1690–92.

"Arkiv *fur* Zoologie," Vol. 30, Nos. 1–2.

Catalogues.

" Books for Students of Medical and Allied Sciences," Macmillan & Co., Ltd., London.

" Monthly List of Books on Natural History and Science,"—November 1938. Wheldon & Wesley Ltd., London.

ACADEMIES AND SOCIETIES.

Indian Academy of Sciences:

November 1938. SECTION B.—RAMA NAGINA SINGH : *The Oedogoniales of the United Provinces, India—I.* G. N. RANGASWAMI AYYANGAR, V. PANDURANGA RAO AND B. W. X. PONNAIYA : *The Occurrence and Inheritance of Purple-tipped Grains in Sorghum.* C. V. GANAPATHY AND B. N. SASTRI : *The Natural Activators of Papain.*

National Academy of Sciences, India:

November 29, 1938.—RAM BEHARI : *Osculating Quadrics of a Ruled Surfac*

Indian Chemical Society:

September 1938.—DINES CHANDRA SEN : *A Method for the Estimation of Cobalt in Presence of Nickel.* PARES CHANDRA BANERJEE : *Use of Vanadous Sulphate as a Reducing Agent, Part III.—Estimation of Cerium.* AMRITANSU SEKHAR CHAKRAVARTI AND BALABHADRA PRASAD: *Viscosity and Density of Cadmium Chloride Solutions at* 35°. N. C. SEN GUPTA : *On the Moving Boundary Method for the Determination of Cataphoresis of Colloids.* MUHAMMAD QUDRAT-I-KHUDA, AKBAR ALI MALLICK (in part) AND ASHUTOSH MUKHERJI : *Strainless Monocyclic Rings, Part III.—Synthesis of* 2-*Methyl*-cyclo*hexane-Succinic Acid and the Separation of its Isomers.* HIRENDRA NATH DAS-GUPTA : *Studies in Organo-arsenic Compounds. Part VIII.—Synthesis of Arsindole Derivatives from Phenylacetylene.* HIRENDRA NATH DAS-GUPTA : *Studies in Organo-arsenic Compounds, Part IX.—Synthesis of Arsenic Analogue of Succinimide.* SISIR KUMAR GUHA : *Indigoid Vat Dyes of the Isatin Series, Part III.—*3-*Indole-*2′-(4′-*methyl*) *Thionaphtheneindigos.* S. S. DESHAPANDE : *Essential Oil from Flower Kewda* (Pandanus Odoratissimus). U. P. BASU : *On Certain Salts of Alkaloids.* P. K. BOSE AND H. H. FINLAYSON *Occurrence of Psoralen in* Phebalium Argentum Smith.

* * *

South Indian Science Association, Bangalore:

November 28, 1938.—DR. M. V. GOVINDASWAMY : *Criminal Children and their Institutional Treatment.*

December 7, 1938.—DR. S. RAJU IYENGAR : *The Health of the School Children.*

December 16, 1938.—MR. C. J. H. PENNING : *Some Aspects of the Indian Sugar Industry.*

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